May, 1973
Price, $1.50

Jerome B. Wiesner:
Technology Is For Mankind

Ross A. McFarland:
Man in Rarefied Atmospheres

William M. Siebert:
Signals and Noise in Sensory Systems

John E. Huguenin:
Living and Working in the Sea

Alan L. Frohman:
Fighting Fires: Only the Truck Is New

Edited at the
Massachusetts Institute
of Technology

Technology Review

technology
review
Published by MIT

SPECIAL REDUCED ALUMNI RATES

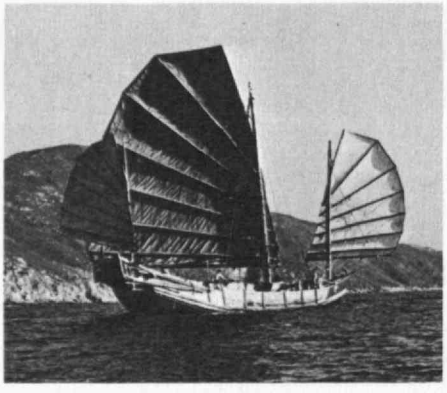
NINTH ANNUAL TOUR PROGRAM—1973

This unique program of tours is offered only to alumni of Harvard, Yale, Princeton, M.I.T., Cornell, Univ. of Pennsylvania, Columbia, Dartmouth and certain other distinguished universities and to members of their families. The tours are designed to take advantage of special reduced air fares which offer savings of hundreds of dollars on air travel. These are not for mass "charter" trips but special fares which apply to regular jet flights of the major scheduled airlines and which are usually available only to groups or in conjunction with a qualified tour. The savings are as much as $500 over the normal air fare, and special rates have also been obtained from hotels and sightseeing companies.

The tour program is consciously designed for persons who normally prefer to travel independently and covers areas where such persons will find it advantageous to travel with a group. The itineraries have been carefully constructed to combine as much as possible the freedom of individual travel with the convenience and savings of group travel. There is an avoidance of regimentation and an emphasis on leisure time, while a comprehensive program of sightseeing ensures a visit to all major points of interest.

The unusual and limited nature of tour membership results in well-educated, intelligent and well-traveled participants. The size of each tour group is limited, with specifics being given in the tour materials.

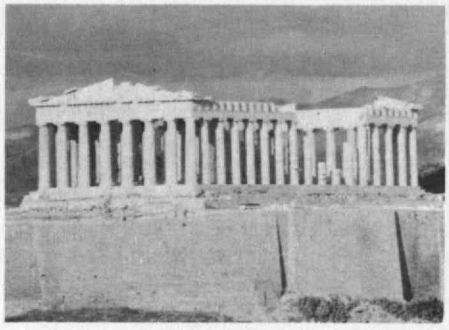
The tours use the best hotel available in every city, and hotel reservations are made as much as two years in advance in order to ensure the finest in accommodations. The names of the hotels are listed in each tour brochure, together with a detailed day-by-day description of the tour itinerary.



THE ORIENT

29 DAYS $1899

This outstanding tour, now in its ninth year of operation, offers the splendor and fascination of the Far East in comfort and at a realistic pace. The itinerary devotes eleven days to the beauty of JAPAN, visiting the modern capital of TOKYO, the lovely FUJI-HAKONE NATIONAL PARK, and places special emphasis on the great "classical" city of KYOTO, where the splendor of ancient Japan has been carefully preserved, together with excursions to NARA, the great medieval shrine at NIKKO, and the giant Daibutsu at KAMAKURA. Also included are BANGKOK, with its glittering temples and palaces; the cosmopolitan metropolis of SINGAPORE, known as the "cross-roads of the East"; the unforgettable beauty of HONG KONG, with its magnificent harbor and famous free-port shopping, and as a special highlight, the fabled island of BALI. Tour dates include outstanding seasonal attractions in Japan, such as the spring cherry blossoms, the beautiful autumn leaves, and some of the greatest annual festivals in the Far East. Total cost is $1899 from California, $2005 from Chicago, and $2172 from New York, with special rates from other cities. Departures in March, April, May, June, July, September, October and November 1973 ($27 additional for departures in July, September and October).



AEGEAN ADVENTURE

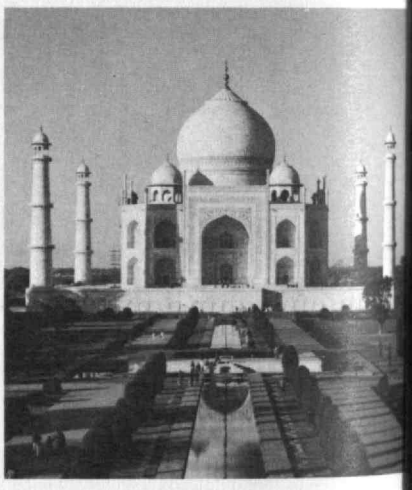
22 DAYS $1429

This original itinerary explores in depth the magnificent scenic, cultural and historic attractions of Greece, the Aegean, and Asia Minor—not only the major cities but also the less accessible sites of ancient cities which have figured so prominently in the history of western civilization, complemented by a cruise to the beautiful islands of the Aegean Sea. Rarely has such an exciting collection of names and places been assembled in a single itinerary—the classical city of ATHENS; the Byzantine and Ottoman splendor of ISTANBUL; the site of the oracle at DELPHI; the sanctuary and stadium at OLYMPIA, where the Olympic Games were first begun; the palace of Agamemnon at MYCENAE; the ruins of ancient TROY; the citadel of PERGAMUM; the marble city of EPHESUS; the ruins of SARDIS in Lydia, where the royal mint of the wealthy Croesus has recently been unearthed; as well as CORINTH, EPIDAUROS, IZMIR (Smyrna) the BOSPORUS and DARDANELLES. The cruise through the beautiful waters of the Aegean will visit such famous islands as CRETE with the Palace of Knossos; RHODES, noted for its great Crusader castles; the windmills of picturesque MYKONOS; the sacred island of DELOS; and the charming islands of PATMOS and SANTORINI. Total cost is $1429 from New York. Departures in April, May, July, August, September and October 1973.

SOUTH AMERICA

32 DAYS $1995

From the towering peaks of the Andes to the vast interior reaches of the Amazon jungle, this tour travels more than ten thousand miles to explore the immense and fascinating continent of South America: a brilliant collection of pre-Colombian gold and a vast underground cathedral carved out of a centuries-old salt mine in BOGOTA; magnificent 16th century churches and quaint Spanish colonial buildings in QUITO, with a drive past the snow-capped peaks of "Volcano Alley" to visit an Indian market; the great viceregal city of LIMA, founded by Pizarro where one can still see Pizarro's mummy and visit the dread Court of the Inquisition; the ancient city of CUZCO, high in the Andes with an excursion to the fabulous "lost city" of MACHU PICCHU; cosmopolitan BUENOS AIRES, with its wide streets and parks and its colorful waterfront district along the River Plate; the beautiful Argentine LAKE DISTRICT in the lower reaches of the Andes; the spectacular IGUASSU FALLS, on the mighty Parana River; the sun-drenched beaches, unforgettable mountains and magnificent harbor of RIO DE JANEIRO (considered by many the most beautiful city in the world); the ultra-modern new city of BRASILIA; and the fascination of the vast Amazon jungle, a thousand miles up river at MANAUS. Total cost is $1995 from Miami, $2080 from New York, with special rates from other cities. Optional pre and post tour visits to Panama and Venezuela are available at no additional air fare. Departures in January, February, April, May, July, September, October and November 1973.



MOGHUL ADVENTURE

29 DAYS $1825

An unusual opportunity to view the outstanding attractions of India and the splendors of ancient Persia, together with the once forbidden mountain kingdom of Nepal. Here is truly an exciting adventure: India's ancient monuments in DELHI; the fabled beauty of KASHMIR amid the snow-clad Himalayas; the holy city of BANARAS on the sacred River Ganges; the exotic temples of KHAJURAHO; renowned AGRA, with the Taj Mahal and other celebrated monuments of the Mogul period such as the Agra Fort and the fabulous deserted city of Fatehpur Sikri; the walled "pink city" of JAIPUR, with an elephant ride at the Amber Fort; the unique and beautiful "lake city" of UDAIPUR; and a thrilling flight into the Himalayas to KATHMANDU, capital of NEPAL, where ancient palaces and temples abound in a land still relatively untouched by modern civilization. In PERSIA (Iran), the visit will include the great 5th century B.C. capital of Darius and Xerxes at PERSEPOLIS; the fabled Persian Renaissance city of ISFAHAN, with its palaces, gardens, bazaars and famous tiled mosques; and the modern capital of TEHERAN. Outstanding accommodations include hotels that once were palaces of Maharajas. Total cost is $1825 from New York. Departures in January, February, August, September, October and November 1973.

THE SOUTH PACIFIC

29 DAYS $2100

An exceptional and comprehensive tour of AUSTRALIA and NEW ZEALAND, with optional post-tour visits to south seas islands such as FIJI and TAHITI. Starting on the North Island of New Zealand, you will visit the country's major city of AUCKLAND, the breathtaking "Glowworm Grotto" at WAITOMO, and the Maori villages, boiling geysers and trout pools of ROTORUA, then fly to New Zealand's South Island to explore the startling beauty of the snow-capped SOUTHERN ALPS, including a flight in a specially-equipped ski plane to land on the Tasman Glacier, followed by the mountains and lakes of QUEENSTOWN with a visit to a sheep station and a thrilling jet-boat ride through the canyons of the Shotover River. Next, the haunting beauty of the fiords at MILFORD SOUND and TE ANAU, followed by the English charm of CHRISTCHURCH, garden city of the southern hemisphere. Then it's on to Australia, the exciting and vibrant continent where the spirit of the "old west" combines with skyscrapers of the 20th century. You'll see the lovely capital of CANBERRA, seek out the Victorian elegance of MELBOURNE, then fly over the vast desert into the interior and the real OUTBACK country to ALICE SPRINGS, where the ranches are so widely separated that school classes are conducted by radio, then explore the undersea wonders of the GREAT BARRIER REEF at CAIRNS, followed by a visit to SYDNEY, magnificently set on one of the world's most beautiful harbors, to feel the dynamic forces which are pushing Australia ahead. Limited visits to South Pacific islands such as Fiji and Tahiti can also be included at no additional air fare. Total cost is $2100 from California. Departures in January, February, April, June, July, September, October and November 1973.

EAST AFRICA

22 DAYS $1739

A luxury "safari" to the great national parks and game reserves of East Africa, offering a breathtaking combination of wildlife and scenery: game viewing in the wilderness of Kenya's Northern Frontier district at SAMBURU RESERVE; a night at world-famous TREETOPS in the ABERDARE NATIONAL PARK; the spectacular masses of pink flamingos at LAKE NAKURU; multitudes of lion, zebra, wildebeest and other plains game in the MASAI-MARA RESERVE and the famed SERENGETI PLAINS; the great permanent concentrations of wildlife in the NGORONGORO CRATER; tree-climbing lions along the shores of LAKE MANYARA in the Rift Valley; photographing rhino and other big game against the majestic snow-covered background of Mt. Kilimanjaro in the AMBOSELI RESERVE; and the vast and fascinating wilderness of TSAVO NATIONAL PARK, renowned for its elephant and lion and for the unusual desert phenomenon of the Mzima Springs. There is also a stay in NAIROBI, the most fascinating city in East Africa, as well as features such as a visit to a MASAI MANYATTA to see tribal dancing and the tribal way of life. The altitude in East Africa provides an unusually stimulating climate, with bright days and crisp evenings (frequently around a log fire), and the tour follows a realistic pace which ensures a full appreciation of the attractions visited. Total cost is $1739 from New York. Optional extensions are available to the VICTORIA FALLS, on the mighty Zambezi River between Zambia and Rhodesia, to UGANDA, and to the historic attractions of ETHIOPIA. Departures in January, February, March, May, June, July, August, September, October, November and December 1973 ($26 additional for departures in June, July and August).

NORTH AFRICAN ADVENTURE

Preliminary Announcement

A new tour to North Africa and the regions which surround it, visiting GIBRALTAR, MOROCCO and the CANARY ISLANDS. GIBRALTAR, the gateway to North Africa, is the first stop, followed by a crossing of the narrow Strait of Gibraltar to TANGIER, on Morocco's northern coast. From Tangier, the tour proceeds by road to the imperial cities of MEKNES and FES, with an excursion to the Roman ruins of VOLUBILIS, then crosses the Atlas Mountains to the pre-Sahara and ERFOUD, on the edge of the desert. From here, the famed "casbah trail" leads through TINERHIR and OUARZAZATE to MARRAKECH, where an extended stay is provided before continuing to CASABLANCA. The visit to the CANARY ISLANDS, lying off the coast of Africa, will include stops in TENERIFE, the volcanic island of LANZEROTE, and LAS PALMAS. It is anticipated that the tour will be of three weeks' duration and that it will be inaugurated in the fall of 1973. Further details, including the tour cost, will be announced as soon as possible.

MEDITERRANEAN ODYSSEY

Preliminary Announcement

An unusual blend of countries in the Mediterranean area, visiting TUNISIA, the Dalmatian Coast of YUGOSLAVIA, and MALTA. Starting in TUNIS, the tour explores the coast and interior of Tunisia: the ruins of the famed ancient city of CARTHAGE as well as the ruins of extensive Roman cities such as DOUGGA, SBEITLA, THUBURBO MAJUS and the magnificent amphitheater of EL DJEM, historic Arab towns and cities such as NABEUL, HAMMAMET, SOUSSE and KAIROUAN, the caves of the troglodytes at MATMATA, beautiful beaches at ZARZIS and on the "Isle of the Lotus Eaters" at DJERBA, and desert oases at GABES, TOZEUR and NEFTA. The beautiful Dalmatian Coast of Yugoslavia is represented by SPLIT, with its famous Palace of Diocletian, and the medieval walled city of DUBROVNIK, followed by the island of MALTA, with its treasure house of 17th and 18th century churches and palaces, where the Knights of St. John, driven from the Holy Land and from Rhodes, withstood the epic seige of the Turks and helped to decide the fate of Europe. It is anticipated that the tour will be of three weeks' duration and that it will be inaugurated in the fall of 1973. Further details, including the tour cost, will be announced as soon as possible.

* * *

Rates include Jet Air, Deluxe Hotels, Most Meals, Sightseeing, Transfers, Tips and Taxes. Individual brochures on each tour are available, setting forth the detailed itinerary, hotels used, and other relevant information.

* * *

For Full Details Contact:

ALUMNI FLIGHTS ABROAD
White Plains Plaza
One North Broadway
White Plains, N.Y. 10601

Would you buy it without going inside?

If anybody offers you a price that looks better than ours, you'd better make sure you know exactly what you're getting.

We've just built a low-priced FDM data transmission system that's the best value on the market: the GTE Lenkurt model 25C. Go inside and take a look around . . . you'll find intermixable speeds from 110 to 600 baud. You'll find a built-in 20 mA local telegraph interface for on-premises printer applications. You'll find local/remote test features and a built-in carrier alarm lamp. You'll find it meets TTL, S-level and EIA/CCITT interface standards. And you'll find all the quality and precision we've been known for during 25 years of building data transmission systems.

The 25C comes as an attractive single-channel subset. Or the same duplex channel unit can be shelf mounted — up to 8 channels per shelf with a maximum of 18 channels (110 baud) on each VF line. So it lets you use just one voice channel rather than a lot of data lines. And it lets you do it at a very reasonable price. Add to that the 25C's economy of maintenance and you end up with a bundle of savings.

Write GTE Lenkurt Incorporated, Dept. C720, 1105 County Rd., San Carlos, CA 94070. We'll send you all the inside information.

GTE LENKURT

Technology Review

Edited at the
Massachusetts Institute of Technology
Volume 75, Number 6
May, 1973

Articles

Departments

First Line

Coming in June

Three articles will assure the timeliness of *Technology Review* for June:

☐ In "Energy: A Strategy of Diversity," Edward E. David, Jr., the former White House science adviser who is now Executive Vice President of Gould, Inc., proclaims his confidence in the many-faceted approach to energy problems which is current federal policy—in contrast to a monolithic technological attack.

☐ In a two-part series on the transportation of North Slope oil in our June and July/August issues, Richard A. Rice, Professor of Transportation at Carnegie-Mellon University, will review the analysis which leads him to prefer a continental railroad and gas pipeline to the trans-Alaskan pipeline-tanker system for bringing us the new wealth of the Far North.

☐ Two articles on the present status of and future goals for women in science and engineering, by Roberta Nichols of Aerospace Corp. and a Boston-based group of professional women calling themselves Women in Science and Engineering, will commemorate the 100th anniversary of the graduation from M.I.T. of Ellen H. Richards, the Institute's first coed. Women have indeed come a long way since then—but not as far, by far, as they should, or wish.

Also in June: the first part of two-part series on sound recording and reproduction by Amar G. Bose, Professor of Electrical Engineering at M.I.T.; and a report on the year-long mission of the first earth-monitoring satellite by Daniel J. Fink, Vice President of General Electric Co.

"Trolley to the Moon"

The late Eric Hodgins (M.I.T.'22) brought distinction to *Technology Review* as its Managing Editor from 1922 to 1927, and now he has done so again with the posthumous publication of his autobiography, *Trolley to the Moon* (New York: Simon and Schuster, $10). Edward Weeks, reviewing the book in the *Atlantic Monthly,* says Mr. Hodgins ("one of the ablest journalists I have ever known") wrote "with a wallop and irreverent humor." Both descriptions are appropriate to Mr. Hodgins' remarks about the M.I.T. of the 1920s and the affairs of this magazine under his and Harold E. Lobdell's (the Editor) stewardship. More in a future issue.—J.M.

Letters

Attribution Incorrect

We would like to point out that the article appearing in the February issue of *Technology Review ("Trend of Affairs," pp. 62-63)* is misleading. We have in no way taken credit for the general concept of proteins facilitating transport by forming pores in biological membranes, nor can this be inferred from our paper (appearing in *Membranes and Viruses in Clinical and Experimental Diseases,* 1972, S. Day and R. Good, eds., Academic Press, N. Y., p. 49) on which this report is based. Our work has focused on *specific* physical mechanisms which may give rise to selectivity and gating in such, as yet hypothetical, protein pores.

The general concept of protein gates in the nerve membrane is an idea which cannot be attributed to any one person or group. It has emerged gradually over many years due to the steady efforts of numerous workers in this field.

Kenneth J. Rothschild
H. Eugene Stanley
Cambridge, Mass.

Technology Review, Reg. U.S. Patent Office, is published eight times each year (in October/November, December, January, February, March/April, May, June, and July/August) at the Massachusetts Institute of Technology; two special editions are provided for graduate (pp. 1-80) and undergraduate (pp. 1-112) alumni of M.I.T. Entire contents copyright 1973 by the Alumni Association of the Massachusetts Institute of Technology. Technology Review is printed by the Lew A. Cummings Company, Manchester, New Hampshire. Second class postage paid at Boston, Mass., and at additional mailing offices.

Inquiries regarding editorial contents, subscriptions, and advertising should be addressed to: Technology Review, Room E19-430, Massachusetts Institute of Technology, Cambridge Mass., 02139. Telephone area code (617) 253-4872.

Price: $1.50 per copy, $9 per year in the United States, $10 in Canada and foreign countries. Please allow three weeks for changes of address, and give both old and new addresses in all requests.

Technology Review is represented for advertising by: Littell-Murray-Barnhill, Inc., 60 E. 42nd Street, New York, N.Y., 10017, telephone (212) 867-3660; Cole, Mason and Deming, 221 No. LaSalle Street, Chicago, Ill., 60601, telephone (312) 641-1254; Zander, Coughlin and Thompson, 5478 Wilshire Boulevard, Los Angeles, Calif., 90036, telephone (213) 938-0111 and 22 Battery Street, San Francisco, Calif., 94111, telephone (415) 398-4444.

The Review *regrets having caused embarrassment to Professors Rothschild and Stanley and anguish to other workers in the field.—Ed.*

Correction, Please

I wish to correct an error made in estimating the ratio of solar absorption at the earth's surface to world energy consumption in 1970 in "An Agenda for Energy," by the writer and Jack B. Howard (Technology Review *for January, 1972, pp. 38-48).* The number given *(p. 44)* was 6,000; it should have been 12,000. This is based on the known U.S. consumption of 69.6 x 10^{18} B.t.u. (including wood) and the assumptions that the U.S. consumes one-third of the world total (Darmstadt gives 34.8 per cent for 1967) and that cloud albedo and atmospheric absorption combine to permit 46 per cent of the sun's energy to reach the earth's surface.

Hoyt C. Hottel
Department of Chemical Engineering,
M.I.T.

Solar Energy For Millenium Three

I was singularly disappointed in reading the article "Energy for Millenium Three" by Earl Cook (*December, pp. 16-23*). My opinion of this article is that it confuses the energy picture with completely irrelevant facts which do not help one iota to solve the problem. I also believe that some of these facts are incorrectly stated.

We do know today how to obtain solar energy from space by means of satellites in synchronous orbit. While obviously many developments have to take place, the statement that the techniques are not yet known, I consider to be incorrect.

We as a nation and as human beings in this world have to find a solution to our energy problem. I believe that the energy problem is the most important problem confronting humanity today and requires adequate planning. In my way of thinking, the only source of energy available to us without affecting our limited resources on earth and which creates no pollution whatsoever is solar energy from space. I further believe that this merits your editorial attention.

F. D. Helversen
Portland, Ore.
The writer is Director of Engineering at Georgia-Pacific Corp.

Dean Cook responds:

I am aware that my "completely irrelevant facts" may confuse the energy picture for those who would like to believe that human problems should have straightforward engineering solutions. But Mr. Helversen writes as an advocate of a particular "technological fix" for the problem of providing a perennial supply of useful energy to the human population at a sustaining rate.

Solar energy offers an attractive potential for energy supply. Research directed toward demonstrating the technical and economic feasibility of one or more solar-power technologies should be supported. But technical feasibility has not been demonstrated, and it may turn out, as I wrote, that all solar-power technology requires too much capital or too much material to be economically practicable on a large scale.

I did not write, as Mr. Helversen asserts, that "the techniques are not yet known," but rather that the technologies of nuclear and solar energy that must supply the energy needs of man beyond the year 2300 are "not yet known to be feasible, let alone economic". Factors of scale, materials availability, maintenance, and hazard enter into feasibility, along with "techniques."

Mr. Helversen's faith in solar energy to supply "all the energy we need" may ultimately be justified. However, I shall continue, at the risk of "confusing the picture," to suggest that How many we? What is need? How do we get from here to there? and What will it cost? are important questions, and furthermore that Confucius may have had something when he said "Study the past if you would define the future."

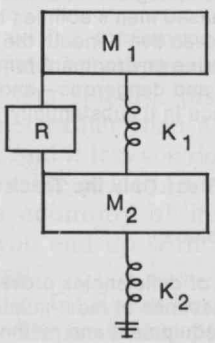
Man-Powered Oscillations

Your recent stories about man-powered airplanes (*January, pp. 59-61*) seem to have re-awakened some old ideas I once had which as far as I know have never been exploited. Here they are.

Some fairly careful guesstimates as to the power output of an oarsman in a racing shell with sliding seat and outriggers came up with 9 h.p. I have no figures on the bicycle mode but feel sure it can't come very near to that. If the airplane project could take advantage of this it might help a great deal.

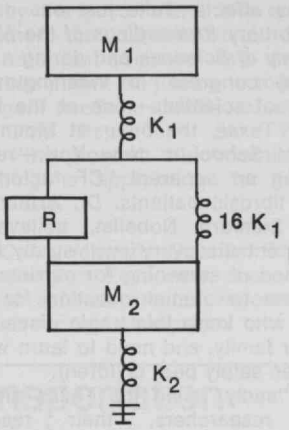
Here is another one for oarsmen. The racing shell is observed to have a large alternating (A.C.) component superposed on the constant (direct, hence D.C.) component of forward velocity. Eliminating this A C. component could save some losses and could increase the D.C. component enough to win more races. The man in the single is out of luck, but for an eight-oared shell it might be great fun to try the following. Let the cox count (repetitively) to eight at a faster rate such that the full 1-to-8 count takes two seconds. Each oarsman starts his stroke at the time when he hears his number. Two adjacent oarsmen would only be out of time by .25 sec., which would probably work. It might be better to start from the stern instead of the bow.

Here is one for the automobiles. The suspension of most automobiles may be shown as in this diagram, where M_1 is



mass of chassis and body (the "sprung" weight), K_1 the compliance of the springs, R the shock absorber, M_2 the mass of wheels and axles (the "unsprung" weight), and K_2 the compliance of the

tires. Most designers choose .6 to 1x critical damping for M_1K_1R, resulting in a certain A-C input impedance seen by the bumpy roadway as the exciter. Whenever the exciter input velocity times the A-C input impedance equals the weight of the car, the tire leaves the ground and control drops to zero. This says we want to lower the input impedance. This may be done by placing R in series with K_1 as shown below. This requires another



spring $16K_1$ to keep the shock absorber from bottoming. The magic in the number 16 is that it keeps both modes critically damped. Try it, you'll like it.
Ben Drisko
Camden, Maine

Positive Feedback on Price Control

Jack C. Page should have considered one important additional topic in his article on "Engineering Social Systems" (*July/August, 1972, pp. 43-47*): the relationships between the cost-of-living index, pay raises tied to this index, and inflation. This is truly a positive feedback system. A linear electrical system with positive feedback and a long time delay oscillates with increasing amplitude until saturation occurs somewhere in the system and a "stable" oscillatory condition develops. The cost-of-living pay increase introduces severe nonlinearity into the economy, since it never goes negative, and tends to convert the oscillatory system into one with pure exponential growth—runaway inflation.

Suppose that negative feedback applied. Whenever the cost-of-living index increased, wages were decreased; and when the index dropped, wages were increased. With a properly selected proportionality constant which would be different for different industries and be related to the labor intensiveness of the product, a stable economy with only minor oscillations could be obtained.

One might argue that since labor is only a fraction of the cost of living, controlling labor alone would not control inflation. Raw materials, machinery, taxes, and profits also need to be controlled. Raw materials are free; they were on the earth when we arrived. They "cost" only because of labor associated with extraction, refining, processing, and distribution. Machinery is made from raw materials and labor. Taxes increase because government costs increase largely due to labor costs (negative feedback should be applied on taxes also). In a stable, free economy, profits will be kept at a reasonable level by competition.

This type of stabilization would not produce the same kind of stability that the Marxian doctrine does—each according to his own needs, providing pure equality and no gain. It would allow true improvements in productivity to lead to real increases in wages and profits.
Ernest W. Bivans
Santa Barbara, Calif.

Hard-Nosed Energy Reality

The essence of the Gordian report on electric home heat (*"Trend of Affairs" for December, p. 55*) is the claim that fossil-fuel heating in the home produces air pollution of the order of magnitude 100 times worse than the air pollution from home heating by electricity produced by a fossil-fueled power station.

By the tongue-in-cheek style of the review, I thought that you had caught the fallacy in this report, particularly in view of the flamboyant quotation attributed to a Westinghouse source, that "the scientific evidence is now in and it's in our favor. . . . Not only does electric heating result in less pollution of the air we breathe, but it conserves our natural resources to boot!" In fact, it does neither by a long shot.

The major point of the report is that a unit quantity of air pollutant emissions from a residential source produces on the order of 100 times the ground-level air pollutant concentrations that would result from that *same* quantity of pollutant emissions from an electric power plant, because of the much greater stack height of the power plant. However, by a conservative estimate, a power plant would emit 10,000 times as much pollutant as a single home furnace! Thus, even if the effect per unit emission of the power plant at ground level is of the order of 0.01 as much as the residence, $10{,}000 \times .01 = 100$, and the power plant would pollute at ground level 100 times as much as the fossil fuel burned in a residence.

One can refine this discussion by bringing in other qualifying factors such as pollution controls; but the basic fallacy is serious, and the gross fact remains that the pollution produced by electric heat is an order of magnitude worse than that produced by fossil-fuel burned in the home, rather than the other way around as has been claimed.

I hope that national energy policy is based on more thorough and profound studies than that referenced here.
Milton D. Rubin
Newton, Mass.

Science Money: Promises, Promises

Washington Report
Victor Cohn

Back in World War I, I've read, the doughboys sang a song (to the tune of *John Brown's Body*) that went:

Every day we sign the payroll,
Every day we sign the payroll,
Every day we sign the payroll,
But we never get a goddam cent.

Thus, federal support of much of science under President Nixon. The opening months of 1972 saw promises, promises, promises—the first science and technology message from an American president, with its pledge "to marshal science and technology" to improve the economy and quality of life, accompanied by the most hopeful research and development budget in years, with a $700 million "increase" for civilian, non-space R&D.

It was about time to end the lean years. The country's growing trade deficit, its growing loss of leadership in "high-technology" manufactures, its own needs—all signaled R&D under-investment, agreed high budgetary and monetary officials like George Shultz, Maurice Stans, and Caspar Weinberger, who were spurred on by Edward E. David, the President's Science Adviser, and by ex-supersonic-transport advocate William Magruder, who had just headed a great multi-departmental exercise seeking "new technological initiatives" through which to attack a few of the problems of this vast, semi-sleeping land.

"The 1973 budget," it was announced in January 1972, "reflects the understanding that R&D makes significant contributions to economic growth and the quality of American life . . . It is clear that a long-range strategy is needed to strengthen the overall national effort in science and technology. A more strategic approach to the nation's R&D should not only improve the ability to deal with a wide range of civilian problems, but also lead to the creation of new markets, new jobs, and improvement in this country's world trade position."

With this kind of backing, the quiet—and, it seemed on that day, quietly effective—Dr. David was able to stand before reporters and crow a little about the sums the President would ask Congress to appropriate for fiscal 1973, the fiscal year that started last July 1.

For many researchers, companies, and universities, it now turns out, fiscal 1973 never arrived. Pressed by inflation, unwilling (as President Johnson and Congress after Congress have been equally unwilling) to levy new taxes, Mr. Nixon simply ordered government agencies to hold back.

Congress, with minor exceptions, voted him the R&D funds that he sought. In health and medical areas, it voted much

"... a budget watcher must always look back over his shoulder..."

more. This helped trigger a Presidential veto of the fiscal 1973 Health, Education and Welfare appropriation. The veto was followed by a second, lesser but still considerable appropriation. That was followed by a second veto. The standoff was complete.

As Congress reconvened fiscal 1973 was half over, and there was soon general resignation to the fact that federal spending in many medical areas would remain at about the fiscal 1972 level. While Congress had unrealistically appropriated, the President had without benefit of announcement ordered a general downgrading of his own fiscal 1973 promises in medicine and elsewhere as well as a host of impoundments of appropriated funds. The full result became apparent only this past January, with the unveiling of—does the pace dizzy?—the budget books for coming fiscal 1974.

Now we could compare (1) fiscal 1973's promised outlays as of early 1972, that brief era of hope and happiness, with (2) fiscal 1973's actual outlays by January 1973 estimate, with (3) the new promises for fiscal 1974.

Outlays and Obligations

A word first about budget-reading. Throughout I emphasize actual "outlays" or "expenditures," to use federal budget terms, rather than future "obligations" or "new obligational authority," which Administration spokesmen always emphasize. Obligations are the promises—the sums which are supposedly committed but in actuality may or may not be spent or may be spent over more than one year. Outlays are the sums that are really arriving.

Obligational figures are important, of course, where programs are truly on the increase; spending then necessarily lags behind planning. But a budget-watcher must always look back over his shoulder to see whether past obligations were ever fulfilled. Budget-making and analyzing are both jobs for Artful Dodgers.

This said, we can now see that:

☐ Total spending for conduct of federal R&D for fiscal 1973 was projected at $16.4 billion a year ago. Instead, $15.8 billion is being spent. And the promise for fiscal '74 of $16.7 billion is only 3.7 per cent above 1971's actual $16.1 billion, which considering inflation, amounts to a reduction.

☐ Spending for R&D facilities was projected at $675 million for fiscal 1972; it turned out to be $697 million. However, we now learn, only $527 million was spent in 1972 rather than the $622 million '72 total estimated last year. Some '72 holdovers obviously swelled the '73 total.

☐ Of the *total* $17.5 billion in R&D outlays promised for fiscal '74, $8.9 billion is for the military—up what is in these days a healthy 5.6 per cent.

☐ Fiscal '74 R&D spending in colleges and universities (the closest the budget comes to giving us a "basic research" figure) is projected at $1.8 billion; using more detailed figures this works out at a 4.9 per cent increase. Officials at a National Science Foundation budget briefing calculated the current "science inflation factor" at 5.5 per cent. The 4.9 per cent jump is based, moreover, on comparison a $1.7 billion '73 estimate. That is considerably less than the $1.9 billion promised for '73 in last year's budget book.

☐ N.S.F. is to spend $585.5 million in fiscal '74, (83 per cent of it on basic research), only 2.2 per cent over 1973. The increase for basic research, according to N.S.F. Director H. Guyford Stever, will be 5 per cent, while the increase for N.S.F.'s "Research for National Needs" will be from $70 to $79 million or 12 per cent.

☐ The National Aeronautics and Space Administration will be squeezed just a little, but remain around a hefty $3 billion. The much heralded but now little noticed National Oceanic and Atmospheric Administration is far less favored. It is down for $365 million, compared with $310 million in '73. But $365 million is less in hard money than the agency's 1972 $341 million, and N.O.A.A. was forbidden this year to spend $54 million on projects originally budgeted by the President or voted by Congress.

Bankrupting Basic Science

Throughout the new budget, the emphasis is on more money for the practical, the applied, the short-term result—to the unhappiness of many scientists and research leaders who fear that we may bankrupt the basic research bank.

Medical research is down in all categories except politically-favored cancer and heart disease. N.O.A.A. beached two research vessels, one of them only 2½ years old. It grounded four research aircraft for the rest of fiscal '73, and two will not fly again. N.S.F. put its Antarctic research vessel, Eltanin, in "ready reserve," which Stever calls "not as total as mothballs." In every research agency, support for graduate students has been further reduced in a process that started two years ago.

There is still—as the year before—the stated intent to use federal R&D funds to shape economic well-being. But the language used to express the commitment is now parsimonious and the commitment is pared thin: "The funds in the 1974 budget for R&D recognize the need for continuing the application of scientific and technological resources to meet pressing civilian problems where R&D can make a contribution. At the same time, the 1974 budget recognizes that how we spend our resources is just as important as how much we spend. All programs are not equally urgent."

One can go to dozens of laboratories to find the effects. Take just one case. In the February *Proceedings of the National Academy of Sciences* and during a March medical congress in Washington, two groups of scientists—one at the University of Texas, the other at Mount Sinai Medical School in New York—reported isolating an apparent "CF factor" from cystic fibrosis patients. Dr. Arthur Kornberg, Stanford Nobelist, believes this "important discovery" will surely lead to a method of screening for carriers of the CF gene (a crucial question for young adults who know this tragic disease runs in their family, and need to learn whether they can safely bear children).

But, "sadly," said the Texas and New York researchers, their respective $40,000 and $75,000 annual NIH grants (from the hard hit National Institute of General Medical Sciences) would not be renewed. Also, they would lose some of their assistants because of the administration's cut-off of stipends for research trainees.

Laboratory Lights Flickering

Specifically targeted research funds, not untargeted training funds, should support young research workers—so goes the current Office of Management and Budget payoff-oriented logic. But what if a laboratory gets neither?

We need payoffs as well as basic research, certainly. Dr. Stever, the new governmental science adviser, assures us that basic research is still being well supported. Kornberg, however, feels that: "Were there an intentional effort to undermine the health and economic welfare of this country for the coming generations, I could imagine nothing more devastating than to stop training young people to do research in basic medical science. Yet this is precisely what has been done."

Kornberg also points out that there are "eddies in science as in rivers" and sometimes reversals in direction—"In recent memory, Lysneko and his followers stifled genetics and molecular biology in the Soviet Union for a whole generation and Soviet medical science and agriculture show the scars."

To Kornberg, "lights are going out in laboratories all over America."

Exaggeration? In many fields, no.

It was atop this kind of news about research financing—good for some people, bad for more—that there also came early this year the drastic science reorganization that made Dr. David leave the White House, flying off to an industrial job in Chicago before the ink on the reorganization announcement was even dry.

There is now no Presidential science adviser. The newly designated adviser to the White House and entire governmental

establishment is Dr. Stever. He is organizing a new "science policy" office to replace the axed Office of Science and Technology, the Presidential advisory mechanism that David headed.

Will this be good or bad for science, technology, and the country? This must be grist for a future column; but one thought has to be added:

Science and technology have fared no worse financially and in some cases better than many of the other activities supported by the government. The question is whether the current United States budget and tax structure and the programs they permit do justice to the country's urgent needs in totality, or whether —per Ohio Republican Sen. William Saxbe—"the program this Administration is pushing is appropriate for Herbert Hoover's day."

Victor Cohn, formerly Science Editor of the Washington Post, *now concentrates on major science-oriented reporting assignments for that newspaper.*

Transportation Sociology

Victor K. McElheny

American transportation planners are now looking increasingly at sociological and political problems. Transportation is less and less a matter of devices and more and more a concern to understand people's wishes to travel. The result is emphasis on some new, unconventional, and contradictory problems.

Defining what the people's wishes for transport are or might be—and how these wishes might be channeled or damped—are much subtler problems than designing a system of aircraft and airports or deciding that Canada would not be a geographical expression without a Canadian Pacific Railroad. So the behavioral science of transportation becomes increasingly important—and turns out to be considerably more complex than conventional transportation technology. The problems are not lessened by limitations on energy supplies, tax money to build transport systems, and land to accommodate them.

The problem of transportation is not a problem of uncontrolled social forces. There is and has been plenty of social control over transportation. But the control is erratic and largely achieved through a messy conflict among social interests—not by any rational system of referenda. Indeed, the miracle is that any new systems have ever been built.

Today's transportation crisis, which turns the minds of transportation researchers and engineers toward social and political questions and makes them realize that transportation systems merely express a society's commitments at a given time, has a materialist basis. This is obvious in the growing if poorly articulated feeling that the United States, the richest society that has ever existed, must now concentrate on protecting what has been gained, not on opening up vast new possibilities. This sort of conservatism, based on unprecedented economic satisfaction, has many manifestations; it is the strength behind environmentalist movements, behind President Nixon's efforts to limit the welfare bureaucracy.

The Airplane Revolution

It is not merely to preserve a swamp in New Jersey that all efforts to obtain a fourth great airport for New York City have been stymied for nearly 20 years. Americans have grown richer than they ever dreamed of being, thanks to an economy which now provides more than twice the real income of 1945. Part of this wealth comes from big airplanes landing and taking off very frequently quite close to big cities, and moving people very quickly at less than twice the energy cost of an intercity bus (6 cents per passenger mile vs. 3.6 cents). Commercial jetliners—now so numerous (around 2,200) and in the air so much (a median of 12 hours a day) that there are many hours every day when 50,000 Americans are aloft in American skies—are a form of enfranchisement in new possibilities. They are wealth-bringing tools.

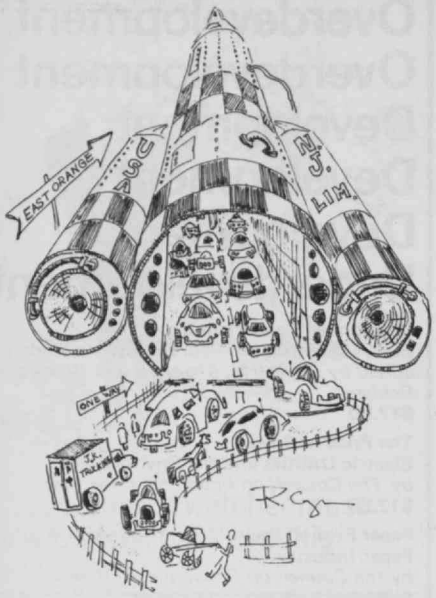
But they also imply limits. Airport space is swallowed up in detached houses, schoolyards, long, low factories, and beautiful corporate headquarters and parkland that newly enriched people are determined to preserve. Those enriched by the airplane revolution are determined to have an aeronautical Thermidor; now that Robespierre had done his work, let him go to the guillotine. No more airports!

The same pressures are built up by interstate highways around and across great cities. These highways, too, have now created enough wealth, and enough vested interests, to stifle the construction of any more such roads in the built-up areas which benefitted most from this style of moving people and goods about.

Now another dilemma is added. There has been extraordinary support for the 1970 Clean Air Act, which mandates drastic reductions in the output of pollutants from internal combustion engines by 1975-76 and clearly will require outright reductions in inner-city auto traffic by the same date. The effects of this Act—higher car prices because of anti-pollution devices and reduced automobile efficiency from the anti-pollution equipment—combined with possible rationing of gasoline (whether from shortages or directly to enforce the Clean Air Act) and a slowdown in highway construction add up to massive challenge to the transportation system on which today's suburban life is founded.

Opting for the Automobile?

If the practical effect of urban politics is to cancel nearly all expressway construction in the inner city, will people grow more willing to subsidize public transport, or will they continue to insist on increasingly long and laborious automobile journeys into the central city?



"... how to harness rocketeers ... to design the subways..."

European and Japanese citizens, despite endemic traffic tie-ups far worse than any in America, seem to opt for automobiles. So do New Yorkers. An interesting social experiment in New York City is enlightening. In 1968 the profits from the seven bridges and two tunnels operated by the Triborough Bridge and Tunnel Authority (which do not include the Hudson River crossings to New Jersey) began to be diverted to help meet the mounting deficits and perhaps boost the number of riders of the New York City Transit Authority. By 1971, the authority was turning over nearly $24 million from a gross of $75 million. In 1972, tolls were drastically increased; the profit jumped to $74 million on a gross of $129 million; but traffic on the bridges and tunnels only declined 8 per cent. In other words, automobile riders are perfectly willing to pay a tax to the subways which could equal the cost of a subway ride—and keep on driving their cars.

In today's situation, the time has passed for simplistic discussion of how to harness rocketeers of the 1960s to design the subways of the 1980s so that we may voyage to South Orange, N.J., as easily as to the moon. Transportation engineers are confident that the technology is there to meet most needs. But what are the needs? There is less emphasis now on the precise aerodynamics of a subway car, or on the total automation of an urban mass transit system, or on the number of passenger miles, or B.t.u.'s of energy to be saved per day by transferring people out of cars into subway cars or buses.

The real problem is to define those transportation requirements about which people feel most strongly—strongly enough so that the plans can be pushed to fruition through the maze of fragmented government structures. What do people really want? What are the politically achievable goals to be achieved by a transportation system? Who would ride trains and buses, and where, and for what? Which social groups would gain new possibilities from a mass transit system? Is the system designed to enlarge the chances of employment of inner-city poor people? Or is its goal to continue to bring upper-middle-class white-collar functionaries to inner-city offices? How much support from most taxpayers is there for such goals?

Or is it possible that large numbers of voters might decide to solve many transportation problems by not solving them? They may continue to drive their cars, or sit in the queues of aircraft awaiting take-off from La Guardia—or they may more and more often choose not to ride at all. Could it be that the trend is ultimately to be against locating activities in the central, relying instead on wide-area telephone service, or telecopying machines, or even—to choose a 19th century example—on letters?

Electronic Transportation-Savers?

There is, in fact a good deal of interest in whether the amazing expansion of electronic communications media since 1945 could not somehow begin to suppress the equally amazing expansion in travel by people. Why not communicate instead of commute?

The answer would seem to be that we communicate *and* commute, and that, to date, the expansion of communications has both intimately supported means of transportation and stimulated the use of those means. Coaches moving over the better roads of 18th-century England carried more letters and faster, stimulating more exchange of goods and people by coach. The same kind of symbiosis exists between telegraphs and railroads, which made their appearance virtually simultaneously, and between the telephone and the airplane. The cost of these intimately linked technologies has been declining rapidly compared to people's income, and each type of communication seems to stimulate, not repress, the other.

The number of telephones in use in the U.S. and the number of local calls per person have been going up about 5 per cent a year for many years (the average is now about four local calls per person per day). The number of toll calls has been rising 10 per cent a year, and the number of overseas calls 25 per cent.

The gain in U.S. air travel has been even steeper. U.S. domestic trunk airlines flew 10 billion revenue passenger miles in 1951 and nearly 100 billion in 1969 (when things began to level off). Revenue passenger miles flown by U.S. airlines on international flights went from 10 billion in 1961 to 60 billion in 1972. Local-service airlines flew 1 billion revenue passenger miles in 1959, 9 billion in 1972.

So far, in very simplistic terms, it seems that there are no fancy transportation-savers hidden in the electronic media.

The Voices Are Confused

Transportation planners now confront a changed social situation, where the technology is available but the voices are confused. Now their classical role of pushing ahead with the next big transportation system—road, canal, railroad, highway is no longer unquestioned.

The tendency in the past was to accept the new means of transport as an end in itself, to define the goal first and weigh the cost later. Extreme cases of this were the Apollo moon-landing program and its military counterparts, where decision-makers defined a goal and were concerned whether it might be accomplished—not modified—within a reasonable time; once specifications were worked out, they were not to be compromised.

As they harness former space engineers to transportation problems, politicians have been showing some naivete. They have assumed that the engineers can be given ironclad specifications, including completion by a fixed date within a fixed cost figure.

The lesson seems to be that one can't have all these things. If the specifications are fixed, then the time and the money must be flexible. If the time and money are fixed, as they often are in politics, then the specifications must be flexible.

But it may turn out that the specifications are unreasonably fancy anyhow. Can anyone really doubt that the Bay Area Rapid Transit System is a socially effective system because it must rely slightly more on its motormen than the specifications called for? Who is harmed by that retreat from ideal specifications?

If this line of reasoning is correct, then perhaps a type of engineering truly beneficial to the public is taking shape. To fulfill all the limits—definite sums from taxes, time-deadlines, effective bans on highways and new airports—the transportation engineer is forced to look for the maximum social utility for the dollar.

This is the way the thinking is going. Who says the engineers are escaping from social control?

Mr. McElheny, formerly European Editor of Science *and more recently Science Editor of the* Boston Globe, *is a free-lance science writer based in Cambridge.*

Disaster Report

Peter Gwynne

During the past year, the populated world appears to have suffered more than its share of natural disasters. Last June, for example, Hurricane Agnes left a trail of flooded communities in its wake; last December a violent earthquake razed the Nicaraguan capital of Managua; in January the eruption of a seemingly inactive volcano off the southern coast of Iceland forced prompt evacuation of the island of Heiamey; and during the early months of this year tornadoes in Texas

M. I. T. Quarter Century Club

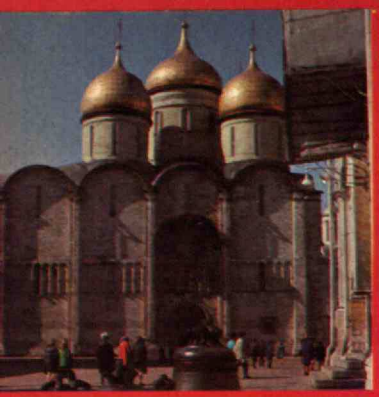
RUSSIAN VISIT

$279**

plus 10% Tax and Service

Departing from Boston
Saturday evening, September 22

Returning to Boston
Monday, October 1




FOR AN UNPRECEDENTED PRICE, OUR TEN DAY TRIP TO MOSC AND LENINGRAD (WITH A PEEK AT HELSINKI, FINLAND) INCLU

Transportation

Our itinerary takes us from the United States to Helsinki (Capital of Finland), then to Leningrad, then to Moscow, and then the reverse.

- Between the United States and Helsinki, we shall be flying round-trip with FINNAIR, the regularly-scheduled international airline of Finland which flies daily between the United States and Scandinavia. Our plane is the large four-engine DC-8 Jet which seats 185 passengers. Delicious full course meals and complimentary beverage will be served aloft each way.
- Between Helsinki and Leningrad, we shall travel round-trip by the beautiful sightseeing motorcoaches of INTOURIST, the U.S.S.R. Company for Foreign Travel, following the picturesque route which crosses the border between East and West.
- Between Leningrad and Moscow, we shall be flying by jet round-trip with AEROFLOT SOVIET AIRLINES, the international airline of the Soviet Union. Complimentary food and beverage (often including Russian caviar and vodka) will be served aloft each way.

First Class Hotel Accommodations

Specific hotel assignments will be made shortly before departure; however, all hotels will meet the standards set forth in the following description:

- For four nights in Moscow, three nights in Leningrad, and one night in Helsinki, we shall be accommodated, on a double-occupancy basis, in twin-bedded rooms with private bath or shower in first-class hotels. Our rooms will be impeccably clean and comfortable, with private telephone and radio or television. The hotels will all have extensive public facilities and services, including restaurant, bar, shops, and travellers' aids.

Meals

In addition to the meals and beverage served in connection with the FINNAIR and AEROFLOT flights,

- Each morning throughout our stay in the Soviet Union, we shall have a delicious breakfast consisting of Russian fruit juices, pastry, cheese, meats, eggs, and coffee.
- One evening in the Soviet Union, we shall enjoy a Russian Banquet Dinner in the manner of a table d'hotel feast. A typical Russian meal (such as Chicken Kiev or Beef Stroganoff) will be served, including after-dinner coffee.

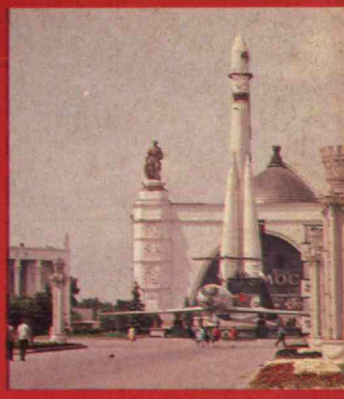
Special Tour Features

- We shall have tickets for a performance of the world-famous Bolshoi Ballet at the Bolshoi Theatre or the Kremlin Palace.
- We shall participate in a Round-Table Interview concerning Russian Life, a unique opportunity for us to ask our questions of Soviet officialdom.
- A special Russian Fashion and Gift Show will be held for us, a chance to see (and buy) the special products of the Soviet Union.
- We shall have tickets for the Moscow Circus or the Central Puppet Theatre, a time of fun for young and old.
- On arrival in the Soviet Union, we are invited for a Get-Together Party with Russian Tea and A Russian Language Lesson, a special occasion for us all.
- Special International Weekends, Inc. "Inside-Info" will provide us with recommendations as to the best restaurants, shops, etc. Additionally, we shall each receive a current events publication and guide magazine for Moscow and Leningrad.
- A Surprise Russian Gift will be given to each of us as a souvenir of the trip, a special example of Russian handicraft we can bring home.
- Throughout the trip, we shall have the services of English-speaking International Weekends, Inc., and Intourist tour host personnel, attractive people to advise and assist us whenever we require.

Sightseeing Tours

- In Moscow, we shall have an extensive half-day motorcoach sightseeing tour, with English-speaking



guide, to show us such important places as *the immense Red Square (center of Moscow's political life and celebrations), The Kremlin (fortress seat of government power), the Grand Kremlin Palace (where the Supreme Soviet and the Soviet Communist Party meet), the Bolshoi Theatre and the Kremlin Palace of Congresses, the Tchaikovsky Concert Hall, Tolstoy's House and Museum, the Monument to Karl Marx, the Dostoevsky Museum, the Lenin Mausoleum (where, in a glass coffin, lies the embalmed body), The Tower of Secrets, St. Basil's Cathedral (onion-domed landmark), the Uspensky Cathedral (housing the walnut throne of Ivan The Terrible), The Moscow University skyscraper, enormous GUM Department Store (the world's largest), the Lenin State Library (the world's largest collection of books, etc.: 30,000,000), the Tretyakov Gallery (richest treasures of Russian fine arts), the fabulous "Children's World" Department Store, the Pushkin Museum, Gogol Boulevard, the State History Museum (300,000 exhibits on Russian history), Gorky Street (Moscow's Grand Boulevard), the Belfry of Ivan the Great (built by Boris Gudonov), The Central Puppet Theatre, the Botanical Gardens, the Revolution Museum (Communist original works), the beautiful Moskva River, the Romen Gypsy Theatre, the Palace of Young Pioneers and Schoolchildren, Lenin Hills, the Peking and Ukraine Hotels, the Crimean Bridge, many churches and the Jewish Synagogue (visited by Golda Meir), the Moscow Zoo, the Foreign Ministry of the U.S.S.R., the Moscow Planetarium, the Hill of Farewells, and more.*

✻ **In Leningrad, another half-day sightseeing tour by motorcoach, with English-speaking guide, will show us such important places as** *The Winter Palace (of the old Czars) which now houses the incredible Hermitage Museum (the world's largest with 2,300,000 exhibits), Admiralty Island (with its imposing tower), the mighty Fortress of Peter and Paul with its Cathedral (where all the Czars, save one, are buried), The Kirov Theatre (cradle of Russian opera and ballet), Gogol's House, the Stroganoff Palace (with its gilded sculptures and white colonnades), Dostoevsky's House, Decembrists' Square (site of the 1825 revolt against the Czar), the battleship Aurora (the ship whose guns signalled the start of the Russian Revolution), The Bronze Horseman Statue of Czar Peter The Great (immortalized by Pushkin's poem), the Youssupov Palace (where Rasputin was shot), the Pavlov Institute (where Pavlov's dog demonstrated the conditioned reflex), the Pushkin Theatre, Turgenev Square, the huge Gostiny Dvor Department Store (incidentally, having the best pastry in Russia), Palace Square (with monolithic Alexander's Column), Nevsky Prospekt (Leningrad's Fifth Avenue), Tauride Palace (where Lenin and Trotsky once lived), The Institute of Theatrical and Musical History, the towering Smolny Church, The Museum of the History of Religion and Atheism, the Cathedral of St. Isaac of Kiev (with its 112 columns), Engineers' Castle (where Czar Paul I was assassinated), the River Neva, the equestrian statue of Czar Nicholas I, the Russian Museum (200,000 works of art), the Workers' Garden (with its statues of Russian poets), Art Place (its theatres include the Philharmonic), the Monument to Catherine The Great, Insurrection Square, Piskaryov Memorial Cemetery (where lie 500,000 World War II victims), Leningrad's Canals and Port, and more.*

✻ **(In Helsinki, our sightseeing motorcoaches will drive us by such important places as** *Senate Square [heart of the town], the State Council Building and the University Library [architectural masterpieces], the beautiful seamaiden fountain of Havis Amanda, Parliament House [with its 55-foot columns], Finlandia Concert Hall and Congress Center, the National Art Gallery, the Greek Orthodox Uspensky Cathedral, the National Theatre, Mannerheimintie [Helsinki's grand boulevard], the President's Palace, the Empress Stone [commemorating Czar Nicholas I's visit], the Helsinki Harbor, and more.)*

Transfers and Luggage Handling

✻ **The trip includes all transfers of persons and luggage (two pieces per passenger) between all airports and hotels as well as porterage of luggage into and out of hotel rooms.**

Taxes, Tipping and Service Charges

✻ **The trip includes "Tax and Service", meaning all taxes, tipping and service charges in connection with the land arrangements inside the Soviet Union, including all tipping for bus drivers, guides, waiters, bellmen, porters, maitres d'hotel, maids, etc.**

THE PRICE AND WHAT IT INCLUDES:
The price shown on the front cover of this folder includes round-trip jet transportation (economy class) between the city of departure in the United States and Helsinki, Finland, round-trip motorcoach transportation between Helsinki and Leningrad, round-trip air transportation between Leningrad and Moscow, transfers of persons and luggage, on all arrivals and departures abroad, between airports and hotels, twin-bedded room accommodations on a double occupancy basis in first-class hotels for four nights in Moscow, three nights in Leningrad, and one night in Helsinki, breakfast each morning in the Soviet Union, one table d'hotel dinner, a half-day city sight seeing tour by motorcoach in both Leningrad and Moscow, a ticket to two performing arts events in the Soviet Union, a lecture-interview in the Soviet Union, a souvenir gift, a Russian fashion-gift exhibition, and the services, on a group basis, of tour host personnel. The phrase "Tax and Service", as used in this folder, means and includes only the taxes, tipping, and service charges with respect to the included land arrangements in the Soviet Union. The constitution of the total price for this trip (transatlantic air transportation, land arrangements, and administration) and possible price fluctuations therefor are set forth elsewhere on the back cover of this folder. The items enumerated in the first sentence of this paragraph are expressed in general terms, because International Weekends, Inc. (the "Travel Agent") reserves the right, without having to refund any monies to the passengers, to alter, change, or make substitutions in the trip, its itinerary, and its features, provided that such alterations, changes or substitutions do not diminish its aggregate fair market value of what is to be included in the trip. The price of this trip does not include expenses of passports, visa fees (including service charges), items of a personal nature such as laundry, telephone, food and beverage other than specifically included, U.S. and Finnish Airport Departure Taxes, currently $3.00 and $2.50 respectively (for which taxes each passenger should be invoiced before departure), or any other item not specifically stated herein to be included in the price of the trip.

SINGLE RESERVATIONS:
The price stated on the front cover of the brochure is per person based on double occupancy of a hotel room. Single reservations require a $59 additional charge.

DOCUMENTS:
Each passenger must obtain and have with him at all times on the trip a valid United States Passport and a Tourist Visa for travel to the Soviet Union. For a Visa Handling Fee, the Travel Agent will obtain the required Tourist Visa (a Visa Application Form will be sent to each passenger upon receipt of his trip deposit).

INTOURIST
The USSR Company for Foreign Travel
16 Marx Avenue
Moscow
USSR

Dear Prospective Tour Participant:

We are very happy to extend to you a most friendly invitation to participate in these charter tours arranged by International Weekends, Inc. We believe they provide an inexpensive and effective way for you to visit our country.

We look forward to welcoming you to the Soviet Union, and Intourist stands ready to assist you here when and as you may request.

Cordially,

American Department
INTOURIST

LUGGAGE:
Each passenger on board the aircraft is limited to 44 lbs. of baggage, subject to the further limitation that he have no more than one suitcase and one small carry-on piece. Throughout the trip, luggage travels strictly at the risk of the passenger, and the Travel Agent shall not be responsible or liable for any delay in the transportation of, for any loss of, or for any damage to passengers' baggage (or its contents). Baggage insurance is available and recommended.

FINAL PAYMENT AND CANCELLATION:
Payment of final balance is due sixty (60) days in advance of departure (at which time reservations will be confirmed). Reservations may only be cancelled by written notice sent by registered mail (return-receipt requested) to the Travel Agent. If such notice is received by the Travel Agent no later than sixty (60) days before departure, the Travel Agent will accept the cancellation and refund all monies. If such written notice is received within sixty days before departure, the Travel Agent will accept such cancellation and refund monies only if the cancelling party finds eligible substitute(s) for the reservation(s) being cancelled. Cancellation insurance (protecting against the loss of air fare) is available and recommended.

ELIGIBILITY:
Participation in this trip is limited to those persons who, for six months preceding departure, have been members of the organization whose name appears on the front cover of this folder, such members' husbands and wives, dependent children and parents, if living in the same household.

INSURANCE:
Ordinary travel insurance is available for those who wish it.

RESPONSIBILITY, ETC.: Each person making reservations for or participating in the trip described in this folder understands and agrees all the terms, conditions, and limitations set forth in this folder including the following: The air transportation for this trip is held out and engaged by the sponsoring organization whose name appears on the front cover of this folder, which organization acts only as agent for the group of persons being transported thereby.

In endeavoring to make arrangements with various persons, firms and corporations for the services and accommodations described in this folder to be included in this trip, International Weekends, Inc. ("Travel Agent") acts only as agent for the participants in the trip and, as such, the Travel Agent shall not be responsible or liable and expressly disclaims any responsibility or liability for, any loss, cost, injury, expense, or damage to person or property which results directly or indirectly, from any act, whether negligent or otherwise, commission or omission (including but not limited to delays), of any person, firm, or corporation which is to, shall, or does provide products or services in connection with the trip including but not limited to transportation services (whether by air, sea, or land), lodging, food and beverage, entertainment, sightseeing, luggage handling or the guiding or escorting. The Travel Agent reserves the right to decline, accept, or retain, at any time and for any reason, any person as a participant in the trip. If any person is removed by the Travel Agent from the trip, a proportionate refund for unused services will be made. The Travel Agent reserves the right to cancel the entire trip for any reason and at any time before departure, in which event the liability, if any, of the Travel Agent shall be limited to refunding to each prospective participant the monies paid to the Travel Agent by such person for the trip, which monies have not been or should not be otherwise refunded to him.

****The price of this trip is constituted as follows: Transatlantic air fare, $129.50 per person; land arrangements, $174.40 per person; administration, $3.00 per person; total price, $306.90 per person. The transatlantic air fare stated above is a pro rata cost to each of 185 passengers; should there be fewer than 185 passengers, each passenger may, at least forty-five days before the departure date, be notified of any increased pro rata cost to him and will have the option to pay the difference or cancel without penalty. The cost of land arrangements stated above is based on the official U.S.S.R. monetary exchange rate of U.S. Dollars to Russian Rubles as existed on March 1, 1973; should there be, between then and the date of departure, a decrease in such official value of the U.S. Dollar in relation to the value of the Russian Ruble, each passenger may be required to pay an increased amount for land arrangements reflecting such decrease.**

The aircraft being utilized for the transatlantic air transportation is a DC-8 jet with seating for 185 passengers. Reservations applications will be processed strictly in order of their receipt by the Travel Agent, with a waiting-list maintained for any reservations in excess of 185. All reservations applications must be mailed, in all events, before the reservations deadline set forth below.

DEADLINE FOR RESERVATIONS

JULY 30

THIS WAY TO RUSSIA

TO: M.I.T. Quarter Century Club
c/o Mr. Jack Newcomb
M.I.T. E-19 275
77 Massachusetts Avenue
Cambridge, Massachusetts 02139
Telephone 723-9600

MY CHECK IS MADE PAYABLE TO:
M.I.T. Quarter Century Club

Enclosed is $_____ ($100.00 per person) as deposit for _____ reservation(s) on the Russian Visit subject to the terms stated in this folder.

NAME (last) _____ (first) _____

ADDRESS _____

CITY _____ STATE _____ ZIP _____

TELEPHONE (9 – 5) _____ (after 5) _____

I have attached to this reservation application a list of the names, addresses and telephone numbers of those persons for whom I request reservations, and I have indicated in each case whether single or double occupancy accommodations are required.

SU923

INTERNATIONAL WEEKENDS, INC.

The Group Travel Specialists
156 State Street
Boston, Massachusetts 02109
Telephone 617/723-8300
TELEX 94-6358 INTL WKNDS BSN

and Florida accounted for sundry deaths and casualties. Yet at the same time, the prospects for predicting such catastrophes are better than ever before. True, scientists are not yet ready to forecast the exact hour, day, or even week of an impending volcanic eruption or earthquake, but the possibilities for successful forecasting in the near future are such as to give sociologists and psychiatrists cause for concern over the reactions of threatened populations to concrete news of forthcoming disaster.

Much of the new understanding of the precursors to disasters has stemmed from technological advances during the past decade in such fields as aerospace, electronics, and optics. For example, devices originally developed for the guidance systems of Minuteman missiles are now performing sterling service as tiltmeters—instruments that measure the minute changes in the slope of the ground that frequently precede earthquakes and volcanic eruptions. In the past, tiltmeters were bulky pieces of equipment that had to be anchored deep in rock, and scientists had to go through a complicated interrogation procedure to record the data they gathered. Now, the missile-developed tiltmeters operate simply from 3-inch holes in the ground, and can relay their readings directly to earth-orbiting satellites. Such simplicity of design makes networks of tiltmeters around active volcanoes and in intensively active earthquake zones entirely practical propositions; indeed, scientists at the United States Geological Survey have already mounted such networks around volcanoes in Central America and the Northwest U.S.

Satellites are also potentially useful to volcano watchers in the monitoring of hot spots on earth from space using ultrasensitive infrared detectors. Soon after the Icelandic volcano engulfed Heiamey Island, for example, its bright glow was detected by sensors aboard the National Oceanic and Atmospheric Administration's (N.O.A.A.) Nimbus-2 satellite. The possibility that the heat of a forthcoming lava outburst can be detected from space before the event is now being explored. At present, infrared sensors may not be precise enough in resolution to give a clear picture of eruption in advance, but in a number of years it should be possible for geologists, forewarned by networks of tiltmeters and other equipment on the ground, to direct satellites' attention to specific volcanoes and receive from the satellites a reading on the possibility of impending eruptions.

Tornado Signals

Electronics is the key for an enterprising new network designed to detect the presence of another kind of destructive natural violence—the tornado. Various groups across the country, under N.O.A.A.'s Environmental Research Laboratories, have developed receivers that sense tornadoes through their emission of electrical energy. Experiments with the devices last year showed that tornadoes may often be differentiated from other storms by their emission rate of more than 20 3.16-megahertz bursts per minute as opposed to a rate of 3 to 13 bursts per minute for less severe storms. N.O.A.A. is operating the detectors at 14 sites in "tornado alley"—the curved swath passing from Oklahoma through Missouri to Florida that suffers much tornado activity. Until the end of June, when activity starts to decrease, the detectors' data will be instantly available to weather forecasters, and should increase the notice local populations receive of twisters on the move.

It is in earthquake studies that the sociological consequences of successful forecasting are most disturbing. In this field, progress towards reliable forecasting and control has been impressive in recent years. One exciting line of investigation concerns an observation made some seven years ago near Denver that pumping water into the ground caused an increase in the number of small-to-medium-size earthquakes in the locality. Intrigued, scientists reversed the procedure, and sure enough, when water was pumped out of the ground the earthquake activity diminished. Then, by pumping the water into the ground once again, the geologists apparently caused more quakes. At present this technique is still in the early experimental stages, but it does suggest a possible way of relieving earth strains—generating minor earthquakes to prevent major ones.

Earthquake forecasting has also provided plenty of excitement in recent months. In the Soviet Union, for example, geologists are studying characteristics of seismic waves, such as changes in their speed, that appear to indicate the onset of medium-sized earthquakes in seismically active areas. These experiments have been repeated, also successfully, in New York State and Southern California.

Another fruitful line of investigation is based on historical data, which suggest that the most likely areas to suffer a quake in a particular belt of seismic activity are those that have not ruptured recently.

Predicting a California Quake

Perhaps most interesting of all is some work reported in April at the annual meeting of the American Geophysical Union by Dr. Robert L. Wesson and William L. Ellsworth of the U.S. Geological Survey. They noted that medium-size earthquakes in California occurring between 1952 and 1972 were inevitably preceded by large numbers of micro-earthquakes, the latter so small that they could only be detected by the most sensitive instruments. The study suggests, according to the two geologists, that microearthquake activity is "a necessary condition for the later occurrence of a moderate or large earthquake in California."

More sensationally, Wesson and Ellsworth discarded the mantle of scientific caution and committed themselves to a forthright prediction—a moderate quake (around magnitude 4.5 on the Richter scale) "within the next several months" along a 12-mile segment of the San Andreas fault about 20 miles southeast of Hollister, Calif.

On examination, that forecast was less sensational than it appeared. For a start, the magnitude of the earthquake predicted is too small to cause any appreciable damage, and earthquakes of this size occur regularly each year in California. Furthermore, Hollister is referred to locally as the earthquake capital of the world, and its 8500 residents are used to the sights and sounds of jangling bottles and breaking glass as the earth heaves beneath the town. The residents regard the prediction as an easy mark, and have treated the whole affair with yawns.

To some extent, that reaction is understandable, but unfortunately it is shared by many cities with a history of massive quakes and the threat of more to come. Even in San Francisco, scene of the disastrous 1906 earthquake, evacuation plans and other preparations for disaster are minimal. "Individuals and communities," declares a recent joint report by the National Bureau of Standards and the National Science Foundation, "have come to rely on governmental help after a disaster rather than develop an awareness of disasters and take feasible preventive measures."

Just as distressing for psychologists is the apparent inability of communities facing the aftermath of natural disaster to realize the psychological strains that such an event puts on each and every person in the community, whether or not he or she is directly affected by the catastrophe. In the weeks after a flood, earthquake, or similar act of God strikes a community, the number of suicides and the hospital admissions for psychiatric reasons increase spectacularly and apparently inevitably.

This problem received little attention until last summer when, in the aftermath of a huge flood caused by Hurricane Agnes, the leaders of the town of Corning, N.Y., called in Ann Kliman, a psychologist at the Center for Preventive Psychiatry in White Plains, N.Y. Ms. Kliman specializes in helping children to deal with the emotional effects of family crises, such as the death of a parent, and she decided that she could fruitfully apply the techniques of that specialty to Corning's community problem. She trained health professionals and volunteers to recognize—through phone calls, everyday conversation, and other encounters—the obvious signs of psychological distress resulting from the flood, and to encourage the victims to talk out their worries. The results were gratifying. For while other communities flooded by Agnes reported the normal increases in suicides and psychiatric ward admissions in the weeks after the event, the statistics in Corning remained stable.

Plainly, then, the outlook in disaster prediction and management is brighter than it was just a few years ago. The prospects that towns and cities will receive reasonable warnings of impending catastrophe are increasing, and a few communities have shown the validity of planning for the after-effects of disaster as well as for disaster itself. But it is also clear that many city leaders still have a lot to learn when it comes to anticipating and coping with disaster.

Formerly the Managing Editor of Technology Review, *Peter Gwynne is now Associate Editor of* Newsweek.

Jerome B. Wiesner
President of M.I.T.

Technology Is For Mankind

We are learning that technology can contend with itself as well as with nature. To abandon this source of man's strength is now a senseless alternative to its further development and use.

A deep mistrust of science and technology is expressed by many in our society today. Were it to prevail, this sense of suspicion and frustration could result in our failure not only to solve our present crises, some of them the result of past misuses of technology, but as well in our inability in the future to deal with problems we may not now even be in a position to predict.

The antagonism against the role of the scientist in society is very broad: it is seriously proposed that we deemphasize basic scientific research along with technology, even that we attempt a moratorium on all new work in these fields.

Scholars such as Everett Mendelsohn, Lewis Mumford, and Herbert Marcuse claim, essentially, that modern science is a false god that must be eliminated, lest the scientific method inevitably lead to a dehumanized society, and possibly even total destruction. An increasingly large number of people, aware of the unexpected and serious side-effects of technology, express more pragmatic concerns. They suggest that most of our forward momentum in science and all of it in technology —if in fact they distinguish between the two—be halted until we have conquered pollution, urban blight, and the other frustrating problems of our day, and until we have eliminated the dangers inherent in the arms race and in our apparently rapid exhaustion of the raw material supplies of the planet.

These represent, in fact, two distinct lines of argument. The relationship of quantitative thought to humanism, a philosophic issue with which men have wrestled since even before the great Greek mathematicians, continues to elude our understanding and in fact remains unanswerable for us.

But to the more pragmatic issue of technological progress, let us be clear and unequivocal: we cannot change the way man has exploited and become dependent on his environment through his greater understanding of science and its application. To think we can make amends now by abandoning scientific knowledge and technical skills is at best romantic, at least worse than futile. The fact is that many of the problems the world faces will require substantial doses of new technology if they are to be solved—sensitively relevant technology, conceived and developed with the understanding that technology can create problems, too.

On the other hand, we must also understand that even a relevant technology alone will not suffice. We need other things desperately—perhaps even more—and these involve the broadest spectrum of interests in the humanities and social sciences. We need especially to develop the ability to estimate rationally and to choose among alternate courses of action, particularly when new technology is concerned. Above all, we need the humility to admit that we will not find any absolute answers or permanent solutions.

Over the past twelve years, I have been in a unique position to feel the antagonism toward technology, and I have frequently been attacked for the many alleged wrongs of the scientific community. When I was President Kennedy's Special Assistant for Science and Technology, many critics of American science seemed to hold me personally responsible for the things they didn't like, be they the moon race, pollution, U.S. military policy, the deterioration of American cities, or the effects of television on children. (Even President Kennedy called it "your space program" when he was complaining about its cost.)

Since I became President of M.I.T., I find that I am once again held responsible for the impact of technology on our society. While neither I, personally, nor M.I.T. can really take credit for creating the perplexing world in which we live, my exposed position leads me to try to understand the worries that people have and to think about what we can do to solve our problems. As the President's Science Advisor, I learned to see individual problems as parts of a large, on-going evolutionary process, and this has helped me understand what we are contending with.

Modifying Technology and Its Effects

Two issues underlie much of the fear of technology: the widely held suspicion that most of society's serious difficulties stem from the careless or malicious exploitation of technology in the recent past; and the conviction that this exploitation will continue in the future. Moreover, since the future that is predicted is a linear extrapolation of the

Jerome B. Wiesner became President of M.I.T. in 1971 after a distinguished career as an electrical engineer and as a statesman for science. He first came to the Institute for work in its Radiation Laboratory during World War II, and he later had an important part in developing from it the Institute's prototype interdepartmental laboratory, the Research Laboratory of Electronics, of which he was for a number of years Director. He was Science Advisor in the White House during John F. Kennedy's Presidency, and in this and many other assignments he has been clearly identified with the view that science and technology have broad responsibilities as well as potential for further improving the societies which they serve.

past, the result is the doomsday prediction we hear so often today.

The fallacy of this argument, I believe, is that it ignores the considerable evidence we already have that man can in fact modify his behavior fast enough to avoid the catastrophic disasters predicted by the doomsday-sayers. To cite just a few examples:

In her book, *Silent Spring*, Rachel Carson warned of the dangers from persistent pesticides. Today, scarcely a decade later, those chemicals are severely controlled—possibly too much so—and biodegradable equivalents are on the verge of being introduced. Although many of us have already forgotten, it was also a mere ten years ago, before the partial nuclear test ban effectively halted large-scale radioactive poisoning of the atmosphere by the United States and the Soviet Union, that mothers were afraid to give milk to their children because of the strontium-90 it contained from fallout. Fifteen years ago the arms race made the danger of nuclear war very real; last year saw major steps toward nuclear arms limitation. Marine life in Lake Michigan was on the verge of extinction a decade ago; by vigorous ecological controls it has been restored.

These are but a few of the many responses that can be seen in our society. It is even possible to argue the case, as Alvin Toffler has, that much of the turmoil in the world is due to the fact that so many things are changing at once.

Obviously, it is important to listen to the critics and to try to understand them, for they are part of the process by which we learn. It is even more important to institutionalize the critical function in our society so that we need not in the future depend upon the chance appearance of a Rachel Carson or a Ralph Nader; we need to make a habit of at least trying to weigh the costs of the various choices we have before we choose one.

Most of the unexpected and serious side-effects of the application of technology—including the remarkable accomplishments of modern medicine—became major problems or threats because we failed to appreciate the power of exponential growth. In the past we responded, or did not respond, to problems as though we lived in a linear world; there seemed to be plenty of time in some distant future to correct the little troubles we preferred to ignore at the moment.

We have, I think, learned an important lesson: we can no longer charge ahead, applying technology blindly and capriciously, without coming into serious trouble. We now understand our capacity to affect our environment in all of its aspects with such power and on so large a scale that the results threaten our very existence. But even if our society *is* learning how to deal with these problems, we need to speed up this development.

This will not be easy. It will require the joint effort of people from many disciplines. It will involve new technology coupled with conscious experimentation in social process. It will involve bringing many more people into the process, and its success will require much greater general public understanding of the nature of science and of technology, of the relationships between them and their impact on social evolution. In some sense, we have been doing a good deal of this in the past: a few farsighted individuals anticipated most of the problems we face today. But society could not respond at any level—industrial, governmental or university. No one was concerned. The important fact is that we have now begun to recognize the need for coupling our foresight of technology with our effort to understand the social process.

Today a wide spectrum of citizens, industrial organizations, governmental agencies, foundations, academic institutions, and "think tanks" are aware and do care. Unfortunately, at the moment our caring exceeds our understanding and our ability to manage. Much of the challenge of the next decade lies in learning how to use our technological and social capabilities and resources in a constructive and responsible manner—and to do this while still enhancing our technical capabilities.

Error Signals for Feedback Channels

Most learning occurs through an experimental or trial-and-error process that involves selecting a goal, taking a tentative step toward it, and comparing the result with the objective. Then, if the result appears to be in the desired direction, we may take a second step. If the direction appears to be wrong, corrective action is required.

Societies can be considered large, complex, learning machines trying to satisfy the wants and desires of their citizens. What makes the situation vastly more complicated are the different goals of different members of the society and the fact that not all citizens have an equal voice in the decisions. In fact, individuals may have very different influences on different issues.

Obviously, too, the political system of a country affects in a very major way how choices are made. In free-

enterprise countries such as ours, most of the decisions regarding the allocation of resources are the result of individual choices (though in every country there have always been areas such as internal and external security and education where collective actions were deemed necessary). As our society has become more complex, the number of areas where some branch of government acts for us, or inhibits our individual or group initiatives, has increased rapidly. While these trends are no doubt inevitable in an ever more complex society, they do slow down the learning process, since "feedback loops" that involve governmental action tend to be long and insensitive.

Those who have studied feedback-control systems known what happens when a system suffers from these defects. A long, slow feedback channel tends to make a system oscillate. The error signal arrives too late, with the result that the system continues to provide correction after the need for it has passed, and the controlled variable is driven too far in the new direction. Eventually, a new error signal will call for a new correction and the whole late-response effect is repeated in the other direction. (Early automobile power-steering systems suffered from this disease; we can clearly see this effect in the attempt to control the economy.) This kind of difficulty can be corrected by shortening the response time of the feedback circuit.

Or if the sensitivity of the error-detecting system is too low, only a large error is sufficient to cause any corrective action to take place. The same effect of over compensation is the likely result.

If we view our system in this light, it is clear that we are in an interim stage, with society trying to learn how to deal with new and not fully understood problems arising from the successful application of technology. We have not yet developed adequate processes for detecting or responding to contemporary problems that require collective action.

Controlling Nature vs. Controlling Technology

Until recent times it was not vital to do so. For most of man's history the challenge lay in coping with the natural environment, modifying or dealing with it so as to eke out a living. But within the past half century we have increased our knowledge, multiplied the forces under our control, and extended the effectiveness of our activities so much that the proper development and control of the rapidly changing synthetic environment has become as important as contending with nature.

This is what we are contending with today. Although we now recognize the need to be concerned about the total impact of large-scale exploitation of any technology and to be on the lookout for unexpected side effects which can occur from widespread and long-time uses of new processes, materials, and devices, we have just begun to develop techniques for doing this.

Our responses to some problems will probably oscillate violently for a while as we try to find the optimum way of dealing with them. For too long we were insensitive to the need to deal with the secondary problems brought on by exploiting technology; now that we recognize them, we may well over-react in many situations. Indeed, at the moment our efforts show this classical defect of a poorly designed feedback system. For example, our tardy recognition of environmental problems associated with electric power generation and our consequent inability to correct the situation rapidly has delayed construction of new power plants. As a result, many regions of the country are threatened with serious power shortages.

Those who see only the evils of technology fail to recognize that our situation would be much worse if the search for new technological solutions was stopped. The development of automotive pollution control devices illustrates this point. The technical problems are difficult and will no doubt take a long time to solve. But the alternatives would be to live with the consequences of pollution or give up automotive transportation—neither acceptable choices to most people. Meanwhile, perhaps, some intermediate steps—such as smaller cars and better mass transportation—will help.

A similar situation exists in almost all fields where the society confronts a difficulty that has its origin in labor-saving or life-expanding technologies.

The great irony of our present dilemma is that it is the consequence of success. As long as the advantages of technology benefited only a few people, they did not create large-scale environmental and social problems. To abandon these advantages to rid ourselves of the problems is hardly an adequate solution; in fact, it is obviously impossible. The great challenge is to move on from where we are to technologies and ways of employing them that will avoid uncontrollable effects in the future. Stopping science will shut off new knowledge and weaken our efforts to reverse the present situation. Technology alone is not the answer, but

without technological developments few answers are likely to be found.

Evaluation as Well as Discovery

This poses some major challenges for those of us who are engineers and for the institutions in which we work. Not only must we continue to search for technological solutions to the problems of our society, but we must find ways to judge these solutions as parts of a more comprehensive social system in which they must be compatible. No longer should we do something—whether in the civilian sphere or the military—just because we can. This means that some engineers will have to be broadly knowledgeable in order to deal with system problems in which the economic, ecological, esthetic, social and other human aspects may be as crucial as the technical issues, perhaps sometimes even more important.

Engineering schools have a major task before them to teach these aspects of engineering properly, for first they must be understood. Indeed, many schools—including our School of Engineering at M.I.T.—have started to study the range of questions in which technology makes an impact on society in a major way. An example is M.I.T.'s study of energy resources. We will try to relate natural resources, alternate consumption patterns, pollution problems, the impact of new technology—such as coal gasification and liquification, breeder reactors and fusion power—and numerous other factors to each other—and eventually predict what the energy situation of the nation will be at various times in the future, depending upon which scenarios are assumed. The results of such studies should ultimately guide research and exploration efforts, the choice of energy sources, and possibly even the extent to which the nation allows total energy consumption to grow.

Many companies are also beginning to take a comprehensive view of their role in society and are attempting to assess their future role, or that of their industry, in a similar way. Many have formed social-responsibility groups charged with monitoring the social impact of the company's operations, frequently looking at both external and internal questions. These include product safety, plant safety, minority equality in employment, pollution problems, and a host of other issues where the company affects employees' lives or the greater society outside of its walls.

These efforts in industry and universities must become a vital part of the social feedback process, since it is important to have a number of independent assessments of critical issues facing the society. Furthermore, independent organizations should be able to work more quickly and with less timidity than their counterparts in government that would otherwise have the sole responsibility for these study tasks. Clearly each group will see problems from its vantage point, but altogether they should produce a balanced perspective.

A Broader Frontier-Yet Endless

More than thirty years ago Vannevar Bush called science the endless frontier; it remains that today. The range of exciting research now exceeds that which was imaginable when Dr. Bush coined the title. Astrophysics and radio astronomy are showing that the vast universe in which we live is much more complex, dynamic and exciting than was suspected three decades ago. Biologists tumble over each other with discoveries about the fundamental basis of life, physicists probe the infinitesmal and increasingly understand the very nature of energy and matter, the information sciences have opened an unsuspected area of study. With these and others, mankind's growing knowledge marks a vast array of exciting research fields in which the human mind will find excitement and beauty for generations to come.

We have also discovered that the application of knowledge for mankind's benefit has turned out to be more complex and time-consuming than many people once hoped. Human societies, like matter itself, are more complex than once imagined, and every intervention has unforeseen potentials. More power has not made us wiser or more considerate. Only a better understanding of human societies combined with a growing strength from technology will help us achieve a world of decency, of increasing opportunity for individual development, and of true peace. We have only one choice: we cannot stop now—but rather must move on to a higher level of understanding, sophistication, and sensitivity in our exploitation of science, technology, and society in mankind's behalf.

Ross A. McFarland
Guggenheim Professor of
Aerospace Health and Safety,
Emeritus
Harvard School of Public
Health

Man in Rarefied Atmospheres

On May 1, 1966, Nicholas Piantanida, a U.S. parachutist wearing a pressurized suit, attempted to break the world's altitude jumping record over South Dakota. During a balloon ascent at 57,000 feet, a tape recording being made at ground level picked up the noises of helmet decompression to ambient altitude, followed by immediate suit decompression; the words "visor" and "emergency" were also recorded. Twenty-four seconds after his initial cry, the balloon's gondola was cut loose electronically. It fell free for three minutes, until it reached 40,000 feet, when the parachute opened. The gondola descended to the ground in 25 minutes. Piantanida was gasping when he was reached at ground level. He never recovered consciousness, but he lived from May 1 until August 26, 1966 through intensive care and clinical support that included hyperbaric therapy. Studies at the National Institutes of Health in Bethesda, Maryland, determined that the severe oxygen want had caused permanent damage to critical central nervous system tissue, and possibly some nitrogen embolism, in spite of denitrogenation prior to the ascent. The perils of high altitude were tragically apparent.

The latest word on pressurized suits may be found in N.A.S.A. reports of their use by astronauts on the moon. Yet, although the physiological principles for a pressure suit are relevant to the pressurized cabin, it is obvious that the design engineer has a much more difficult problem maintaining life of a large number of passengers in a jumbo jet.

The development of pressurized cabins has been one of the most important aspects of the comfort, reliability, and safety of modern air transportation. Its success has depended on studies of the effects of altitude on the human organism and behavior, and the application of the findings from basic research of the biological, physiological, and medical sciences to the designs of engineering solutions. Accounts of early balloon ascents stimulated many of us to measure precisely under controlled conditions the loss of various sensory and motor functions at high altitudes. These experiments were carried out at high terrestrial altitudes, during aircraft flight, and in laboratory studies at simulated altitudes. Their implications influenced the evolution of aviation.

Ross A. McFarland's first experiments on the effects of high altitude were conducted on R.A.F. pilots at Cambridge University in 1928-30. His work continued at Columbia University, where it led to the first Bureau of Air Commerce regulations on the use of oxygen at high altitudes. In 1935, Dr. McFarland was a member of an expedition to the Chilean Andes, where studies were made on men and animals acclimatized to altitudes as high as 21,000 feet. During the opening of air routes over the Atlantic and Pacific and the Second World War, he conducted studies of flight fatigue. Dr. McFarland was associated with the Harvard Fatigue Laboratory from 1937 to 1946, and has been at the Harvard School of Public Health since 1947, where he is currently Guggenheim Professor, emeritus. This article is based on Dr. McFarland's 1972 Lester D. Gardner Lecture at M.I.T. The lectureship was established by a bequest by the late Major Gardner (M.I.T. '98) which sponsors annual lectures on the history of aviation.

Designing for Altitude

A number of human factors determine the development of pressurized cabins. Once the type of engines to be used determine the speeds, range, and altitudes of flight, the life scientist has a number of questions to consider. What would be the most desirable cabin altitude? Where do the symptoms of altitude become marked or uncomfortable; and especially, where do the symptoms become incapacitating? This raises the question of the effects of a sudden loss of pressure. What emergency procedures can be carried out, and in what way are these procedures related to the design of the aircraft itself?

The aeronautical engineer is well aware of the fact that the type of engines used on air transport partially determines the most desirable flight altitudes. To quote Professor Edward S. Taylor:

"Piston powered aircraft can achieve long range at low altitude flying slowly (at best lift/drag ratio) so that aircraft drag is minimized. However, speed can be increased by flying at higher altitude without sacrificing range (in fact usually with a small improvement due to flying at somewhat higher power where the engine may be more efficient).

"Turbine Powered Aircraft (including jets) *must* fly at high altitude for long range. Efficiency of such engines is strongly dependent on the ratio of turbine inlet temperature to ambient temperature, and turbine engines can be operated at part throttle (low turbine inlet temperature) only with severe penalties in efficiency. In addition to the aerodynamic benefits which can be derived from flying at low atmospheric density, turbine powered craft derive great advantage in engine efficiency from flying at high altitude (up to the tropopause) where the ambient temperature is lower.

"Jet Powered Aircraft are relatively inefficient during take-off. They tend to use large engines to ease this problem. This, and their ability to fly at

The earliest balloon ascents showed man the perils of high altitude. Engineering's most important solution of these perils is the pressurized cabin.

high speed, makes it desirable to cruise at still higher altitude.

"Thus [pressurized cabins] are advantageous for piston aircraft, still more necessary on turbo-propeller machines, indispensible for turbojets, and supersonic aircraft are unthinkable without them."

At this point, the life scientist enters the problem. His major concern is the effects of high altitude on crews and passengers, and human factors analysis suggests that the comfort and well-being of airline passengers would be greatly benefited by having as near sea-level conditions as possible, with cabin altitudes of 3,000-5,000 feet not exceeded.

Early Ascents

As long ago as 1862, the British Association for the Advancement of Science sponsored balloon flights to study the effects of high altitudes. In that year, the Englishmen Glaisher and Coxwell ascended to approximately 29,000 feet. During the flight, Glaisher noticed a series of strange symptoms, notably loss of visual acuity and hearing, and paralysis of the arms and legs. Finally, he lost consciousness. Coxwell's arms were also paralyzed, but he managed to pull the balloon's valve rope with his teeth and start it downward. Both men recovered as the balloon descended. This was man's first encounter with the dangers of high altitude flight.

In 1875, three Frenchmen ascending in a balloon called the "Zénith" had an accident which only Tissandier, a meteorologist, survived. They had learned the use of oxygen, but they had been warned by the French physiologist Paul Bert that the amount they carried was insufficient. In order to preserve the supply they waited too long before using it. The effects of the high altitude impaired their judgement, and they failed to use the oxygen when they needed it. All three lost consciousness at 24-26,000 feet. The balloon descended on its own after reaching 28,000 feet.

This tragedy stimulated Bert to increased research activity, resulting in his book on barometric pressure. He was the first to prove that the principal effects of high altitude are due to the diminished partial pressure of oxygen but his work did not become well known until more than 50 years after his death. Bert's impressions have proved to be essentially correct, and it may be stated with certainty that his work laid the foundation for pressurized aircraft.

The classical studies, in low-pressure chambers or at high altitude, of Haldane, Leonard Hill, Barcroft and others extended the work of Bert, elucidating the respiratory functions of the blood, and other physiological responses to oxygen want. Their findings showed clearly that rate of ascent and altitude attained, as well as length of exposure and the physical characteristics of the individual, were important. They also pointed out that the effects of hypoxia are only one of several problems in ascending to great heights. Others are decompression sickness in its various manifestations (such as bends, chokes, and neurocirculatory collapse); expansion of trapped gases in the gastrointestinal tract, causing abdominal pains; and pain in the middle ear or paranasal sinuses associated with pressure changes.

As early as 1875 the Russian physiologist Mendeleyev, in his book entitled *On the Temperature of the Upper Atmospheric Layers*, wrote: "For safety reasons the observer should be placed in an hermetically sealed bell containing air at normal pressure"—one of the first expressions of the need for pressurized cabins in high altitude flying. The Russians also had their early balloon ascents, some of them ending in tragedy, which they, too, attributed to a reduction in the partial pressure of oxygen.

Between 1931 and 1937, beginning with Professor A. Piccard, a number of successful balloon flights were made in pressurized gondolas to altitudes as high as 72,000 feet, proving that life could be supported through the use of pressurization. However, the pressure gondolas and pressure suits used were not practical for commercial aviation.

Pressurized Aircraft

One of the earliest attempts to pressurize an aircraft was initiated in 1920 by the Army Air Corps at Dayton, Ohio. The first flight was made on June 8, 1921 by Lieutenant Harold R. Harris, Chief of the Flight Test Section. The two seats of a De-Haviland DH-9 observation plane were removed and the area filled with an oval compartment made of steel. The flight controls were located inside the tank, and flight instruments outside the tank could be observed through 5 six-inch glass portholes. The aircraft was powered by a single Liberty engine, and the pressurization was from a propeller-driven unit on the wing. No controls for the pressurization unit were included in the tank. After several attempts, Lieutenant Harris was able to lock the door of the steel compartment after ascending to 3,000 feet. The super-charger had been overdesigned on the expectation there would be leakage through the packing around the control cables.

Shortly after the door was closed, pressure built up within the tank until an altimeter inside registered 3,000 feet *below* sea level, although the outside altimeter showed the plane to be at 3,000 feet *above* sea level. The temperature inside the tank had reached 150°F. Lieutenant Harris placed the plane in a slow glide and landed as quickly as possible. He reported that at no time from shortly after closing the door until the plane came to a stop did the cabin altitude vary from 3,000 feet *below* sea level. He could not recall any particular discomfort, but he was wringing wet with perspiration on landing, which he attributed to his anxiety as well as to the high temperature in the cabin. No additional flights were undertaken with this equipment; the Air Corps had other priorities.

Another early ascent with a pressure cabin airplane was made on August 5, 1935 by Marcel Cogno of France. He ascended to 32,000 feet in a cylindrical pressure cabin, and after a few minutes at that altitude, he descended to 30,000 feet and continued to fly for about 30 minutes. Suddenly, the aircraft fell and crashed. It was surmised that a window of the pressure cabin may have blown out, perhaps from a sudden buildup of pressure during failure of the cabin exhaust system. The autopsy of the pilot revealed a cerebral hemorrhage, as well as bilateral ruptured eardrums.

The Army Air Corps initiated a second pressure cabin airplane project in 1935 to which General Armstrong made significant contributions through the aeromedical research program at Wright Field. It was found that life could be sustained by increasing the partial pressure of oxygen in the compartment through an increase in the pressure of the entire contained atmosphere. The principal findings of Armstrong's study, completed in December 1935, were incorporated in the Lockheed XC-35, delivered in 1937. The flight tests carried out during 1938 were completely successful, and the essential features were soon adopted in both military and civilian aircraft for flight at high altitudes. The success of the XC-35 was widely acclaimed.

The Desire for Higher Altitudes

Between 1935 and 1940, as the performance of aircraft increased, the advantages of obtaining greater height became recognized. Information from the U.S. Weather Bureau and flight tests indicated that favorable conditions could be obtained in regard to turbulence, adverse winds, and icing at 20-25,000 feet. At 20,000 feet, clear weather could be obtained in 95 per cent of the flights and clouds could be readily avoided by making inconsequential detours.

Contracts were placed with Boeing to build the four-engined B307 Stratoliner. Mechanical compressors were produced by General Electric; they were to be driven by extension shafts installed in the numbers one and four engine housings, and were to produce an approximate 8,000 foot cabin altitude at a 15,000 foot airplane altitude. Above 15,000 feet the pressure differential remained constant at 2.5 p.s.i. so that at 20,000 feet the cabin altitude would be 12,400 feet. The pressure equipment operated satisfactorily on the 24th of May, 1940, creating comfortable conditions in the cabin during flight at 18,000 and 19,000 feet totaling 15 hours, 25 minutes.

Studies were made by the author in 1940 on a B307 transport plane purchased by Pan American operating through Miami, Brownsville, Texas, and Central America. During one of the flights, a window was purposely broken out to see what would happen. A number of objects suddenly disappeared through the window. The most interesting result was the sudden fogging of all of the windows and cabin due to the rapid change in temperature.

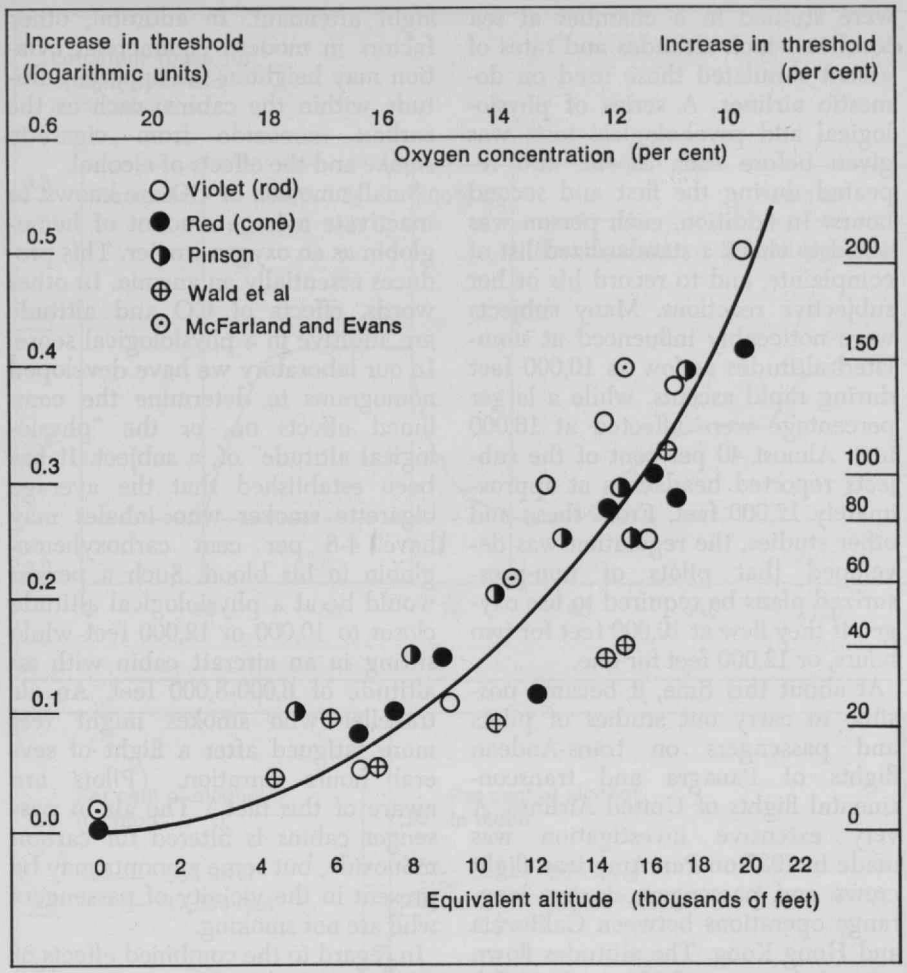
There was general agreement from the tests with the B307 that the cabin pressure differential of 2.5 p.s.i. was too limited and that oxygen masks would be required for crew and passengers in flights above 20,000 (cabin altitude 12,400) feet.

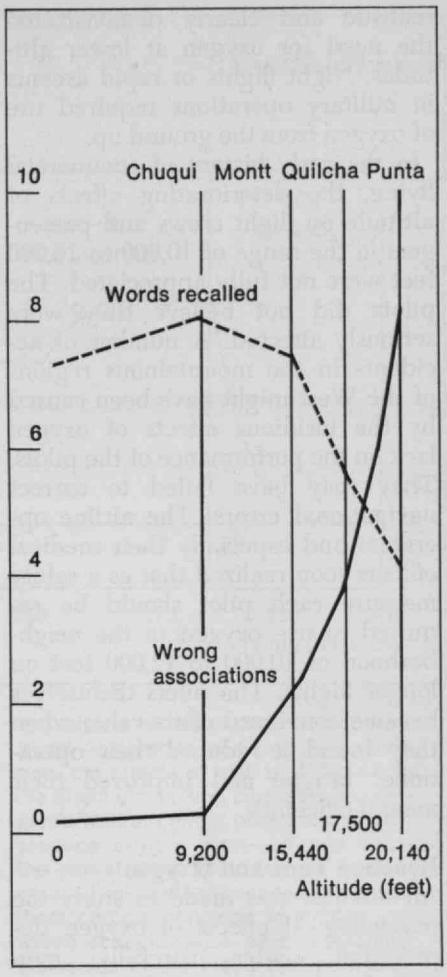
In 1939, a B307 was flown from Seattle to Boston for a conference on high altitude at the Harvard Fatigue Laboratory, and the well-known B-L-B mask was introduced for airline use by Walter Boothby and Randolph Lovelace. In a later Boeing model, the B-29, a cabin altitude of 8,000 feet was maintained up to 30,000 feet at a pressure differential of 6.55 p.s.i. At that time a pressure differential of 7 p.s.i. was recommended for flights of more than three-hour duration, which would provide a cabin altitude of 8,000 feet up to 35,000 feet flight altitude.

Pressurized Warfare

There were wide differences of opinion on whether to pressurize cabins during World War II for fear of loss of pressure from gunfire. Yet several of the major air forces developed planes with pressurized cabins. The Germans had placed a supercharged cabin large enough for two in the front of JU-86's for reconnaissance flights over Egypt at 40,000 feet and above when Rommel's forces were about to enter Cairo in August, 1942. The author spent some time with a squadron which was trying to intercept the JU-86's with Spitfires and oxygen equipment limited to about 35,000 feet. It was necessary to strip down the aircraft to save weight and in the final stages of attack dump fuel and ammunition to reach 40,000 feet. The pilots entered their planes at 120°F in the desert and ascended to about 35,000 feet (where temperatures are 50°F below zero) in 20 minutes. The result was hypoxia and aero-embolism. Though the Spitfire squadron was finally successful, its leader, who was 37 years of age, suffered a severe coronary with psychotic manifestations. Whether these flight operations under these extreme conditions formed the basis of his illness will never be completely determined. The author is aware of two other similar cases of cardiac distress and mental confusion which may have resulted from flights at very high altitude without proper oxygen equipment. However, they may have been the result of a predisposition to heart disease.

Studies made by the Flying Personnel Research Committee of the R.A.F. during 1940-41 determined a most desirable pressure differential for combat aircraft—7-9 p.s.i. However, this high pressure might have several physiological disadvantages in combat at altitudes above 35,000 feet in case of a ruptured cabin, such as decompression sickness, disabling abdominal gas expansion, brief time of useful consciousness and likelihood of forced descent to 20,000 feet or below. A low pressure system—at 2.5-3 p.s.i.—would require the crew to use oxygen continuously above 17,000 feet, but some of the problems would be obviated, so it was recommended for combat aircraft such as the slower, and less well armored bombers. On the other hand it was recommended that commercial aircraft adopt the high pressure system since the risks of





Two of the most sensitive tests for oxygen want. At left, the effect of altitude on vision, shown here in increasing threshold—the minimum light intensity that subjects can see. And at right, the impairment of ability to recall words and make correct word associations in tests of short-term memory. The tests were given to acclimatized subjects at four successively higher altitudes on an Andean expedition.

puncture would be low in non-combat zones.

The decision was made by the War Production Board in the U.S. that transport planes such as the L-49 and DC-4 were not to use pressurization although they had been designed for it. But when the B-29 was developed for the Japanese campaign, a pressurized cabin was incorporated as an essential feature for greater range and ceiling. To be sure, some difficulties were encountered with sudden loss of pressure in military aircraft. In general, however, this feature has become widely accepted for both combat and transport aircraft in the military services.

Vision and Oxygen

As air travel evolved, experimentation progressed on man at high altitudes—real or simulated. During 1930 the author become interested in verifying experimentally the observation that lights became dimmer while breathing gas mixtures deficient in oxygen, then brighter when a normal supply of oxygen is inhaled. This appeared to be true especially at low levels of illumination. In our original studies at Columbia University in 1936-1937, dark adaptation curves were obtained on 20 subjects at sea level and again at approximately 7,000, 11,000, and 15,000 feet. With increasing simulated altitude, the impairment became very significant. Normal values were restored within three or four minutes upon inhaling oxygen. Investigations with more refined equipment at the Harvard Fatigue Laboratory showed that impairment was present at altitudes as low as 4,000 feet. Similar results were obtained using tests for differential light sensitivity experiments concerned with completely dark-adapted eyes. Again, the effects were greater at low levels of illumination. The implications for airplane pilots at night were very direct, and dimness of vision proved to be one of the most sensitive tests for demonstrating the effects of oxygen want at high altitudes.

Altitude Tolerance

Some of the earliest studies on airmen established altitude tolerance limits for pilots in World War I. In these tests each pilot rebreathed a given volume of air, thereby progressively reducing his oxygen supply. The experiments lasted 20-30 minutes, and very high simulated altitudes were reached—up to 25-28,000 feet. The altitude of collapse, taken as the tolerance level, was much higher than if the subject had been exposed to a more gradual "ascent" over a period of one to two hours. Many of these pilots later joined civil airlines. It was often difficult to convince them that they needed to inhale oxygen at much lower altitudes than the point of collapse. In the second World War, the indoctrination tests in low pressure chambers were much more

realistic and clearly demonstrated the need for oxygen at lower altitudes. Night flights or rapid ascents in military operations required use of oxygen from the ground up.

In the early history of commercial flying, the deteriorating effects of altitude on flight crews and passengers in the range of 10,000 to 16,000 feet were not fully appreciated. The pilots did not believe they were seriously affected. A number of accidents in the mountainous regions of the West might have been caused by the insidious effects of oxygen lack on the performance of the pilots. They may have failed to correct navigational errors. The airline operators and especially their medical officers soon realized that as a safety measure each pilot should be required to use oxygen in the neighborhood of 10,000 to 12,000 feet on longer flights. The pilots themselves became convinced of its value when they found it reduced their operational fatigue and improved their mental efficiency.

Reaction Time and Oxygen

An attempt was made to study the psychological effects of oxygen deprivation under carefully controlled laboratory conditions with Henry Barcroft at Cambridge University, England in 1928. The subjects were 15 students in the R.A.F. University Air Squadron. They breathed oxygen mixtures simulating 14,000 to 28,000 feet for short periods of time. Each subject took a series of simple and choice reaction time tests and others involving pursuit tasks and reasoning. The results indicated that simple sensory and motor responses were not seriously impaired until the subject approached collapse, while the choice reaction times and pursuit tasks were influenced at lower altitudes. Performance on tests involving attention, memory and reasoning deteriorated at the higher simulated altitudes. Changes in handwriting were very pronounced. With advanced hypoxia there were unusual alterations in mood and subjects lost insight into certain aspects of their altered behavior.

In 1937 the Bureau of Air Commerce sponsored an extensive investigation at Columbia University under the direction of the author on the effects of altitude on the average airline passenger. Over 200 subjects between 18 and 72 years of age were studied in a chamber at sea level in which altitudes and rates of ascent simulated those used on domestic airlines. A series of physiological and psychological tests was given before each ascent, and repeated during the first and second hours. In addition, each person was asked to check a standardized list of complaints, and to record his or her subjective reactions. Many subjects were noticeably influenced at simulated altitudes as low as 10,000 feet during rapid ascents, while a larger percentage were affected at 16,000 feet. Almost 40 per cent of the subjects reported headaches at approximately 12,000 feet. From these and other studies, the regulation was developed that pilots of non-pressurized plans be required to use oxygen if they flew at 10,000 feet for two hours, or 12,000 feet for one.

At about this time, it became possible to carry out studies of pilots and passengers on trans-Andean flights of Panagra and transcontinental flights of United Airlines. A very extensive investigation was made in 1937 on Pan American flight crews and passengers during long-range operations between California and Hong Kong. The altitudes flown ranged between 8,000 and 12,000 feet. A complete series of psychological and biochemical test results were obtained by H. T. Edwards, a biochemist, and the author. This may have been the first, and possibly the only time that arterial punctures were obtained during flight for determination of the blood gases. In general, the results indicated that there was little in the blood chemistry to suggest excessive physiological fatigue or emotional deterioration. The findings at various altitudes were comparable to those obtained in chamber studies at sea level.

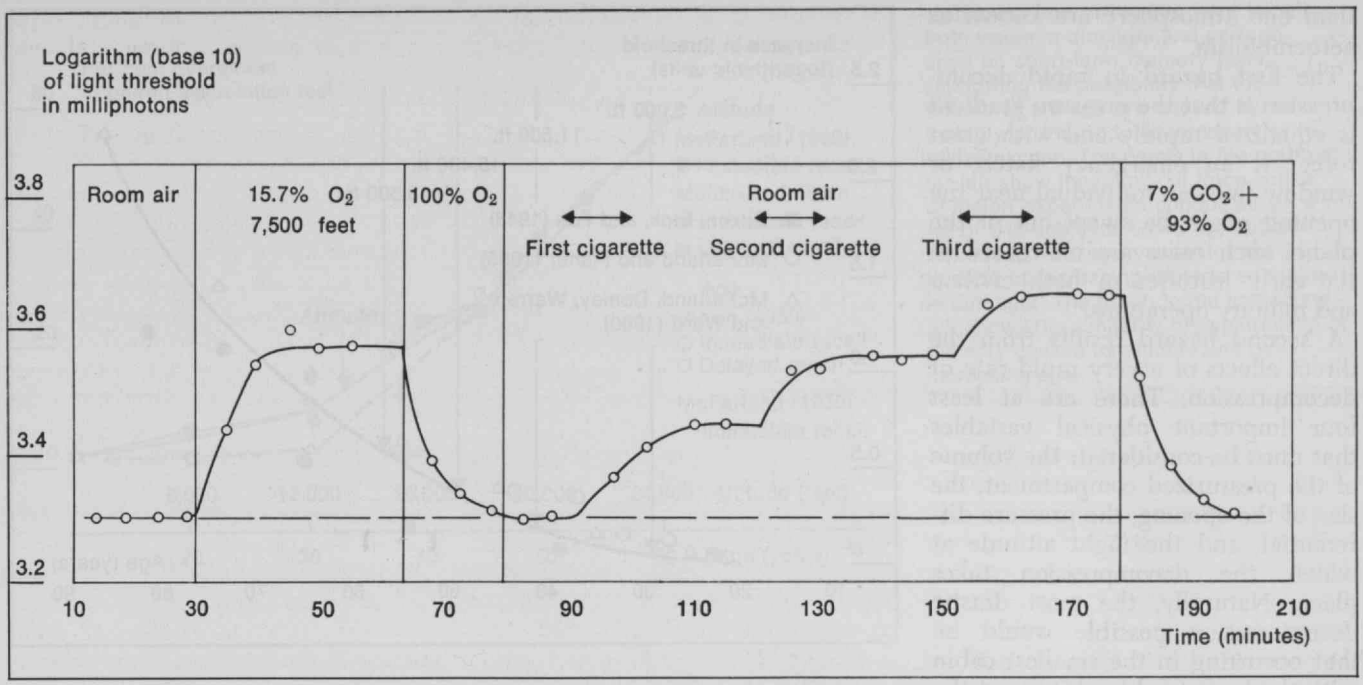
Altitude and Other Influences

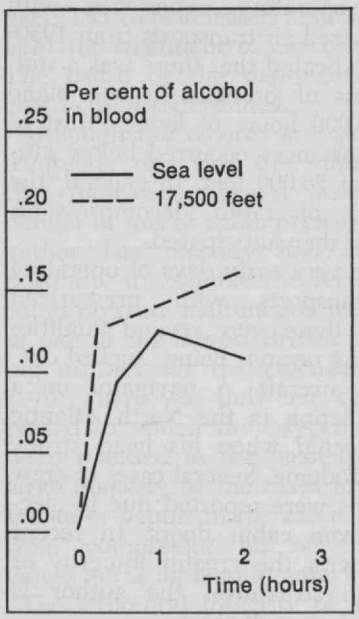
Most of the studies relating to the effects of oxygen want and changes in pressure have been made on young, healthy subjects. The results, therefore, do not always represent a cross section of the air traveling public. Those studies which have been made on unselected samples simulating the composition of passengers on air transports have shown that many took a considerable amount of time to don a mask or "dropout" equipment. Some, of advanced age or under the influence of alcohol, needed the assistance of a flight attendant. In addition, other factors in modern commercial aviation may heighten the apparent altitude within the cabins, such as the carbon monoxide from cigarette smoke and the effects of alcohol.

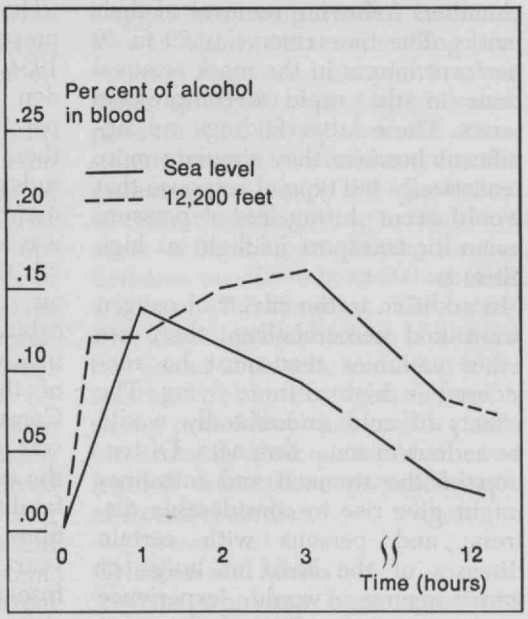
Small amounts of CO are known to inactivate a large amount of hemoglobin as an oxygen carrier. This produces essentially an anemia. In other words, effects of CO and altitude are additive in a physiological sense. In our laboratory we have developed nomograms to determine the combined effects on, or the "physiological altitude" of, a subject. It has been established that the average cigarette smoker who inhales may have 4-8 per cent carboxyhemoglobin in his blood. Such a person would be at a physiological altitude closer to 10,000 or 12,000 feet while sitting in an aircraft cabin with an altitude of 6,000-8,000 feet. An air traveller who smokes might feel more fatigued after a flight of several hours duration. (Pilots are aware of this fact.) The air in passenger cabins is filtered for carbon monoxide, but some amounts may be present in the vicinity of passengers who are not smoking.

In regard to the combined effects of alcohol and altitude, it is now well recognized that the effects may be additive. Alcohol exercises its primary physiological action by depressing oxidation in the cells. Thus alcohol and oxygen want produce more serious effects on the nervous system and consequently on behavior if both are experienced simultaneously. For example, the alcohol in two or three cocktails taken at 6-8,000 feet cabin altitude would tend to have the effects of four or five cocktails at sea level. This amount might tend to impair performance in donning a mask, for example, or in other flight emergencies.

Another important variable in commercial air transportation relates to the age of those being flown. There is a great deal of evidence that infants and small children tolerate moderate altitude very well. However, there may be special problems for pregnant women flying during the first trimester from fairly severe or prolonged oxygen want in non-pressurized aircraft. The fetus may be impaired—congenital abnormalities have been observed in our studies of Andean women residing at great heights. It has been shown







The effects of two staples of modern air travel—cigarettes and liquor—exacerbate the effects of high altitude. Above, the effect of smoking cigarettes is compared with the effect of altitude. Both produce oxygen want—altitude because the partial pressure of oxygen is decreased, cigarettes because in smoking them carbon monoxide is inhaled, which occupies sites on hemoglobin molecules in the blood that normally transport oxygen molecules to the cells of the body. Inhaling the smoke from three cigarettes produces a lack of oxygen—implied here by impairment of vision in dim light—equivalent to conditions at 8,000 feet. At left, the effect of altitude on the metabolism of alcohol. Its concentration in the blood is higher and persists longer at high altitudes. The subjects have imbibed a single drink containing 100 cc. of alcohol.

that older persons, up to 65-70 years of age, respond to moderate altitudes without unusual difficulties. It is only the older person with respiratory or cardiac abnormalities who may suffer ill effects.

It is interesting to note the similarities between the effects of high altitude and age in various psychological and physiological tests. We have noted that two of the most sensitive tests of high altitude relate to measurements of light sensitivity—especially at low levels of illumination—and short-term memory. Every person of increasing age has noted the need for higher levels of illumination in reading. Other similarities between high altitude and aging related to diminished ability to remember recent events. Although it is not possible to specify the basic mechanisms underlying the processes of aging, it is evident that there is a reduced availability of oxygen at high altitude, and reduced metabolic processes within individual cells in the aging person. Based on this interpretation, it is apparent that the aged or infirm passenger might be adversely influenced during long flights above 6-7,000 feet cabin altitude.

The Danger of Decompression

In addition to giving rise to oxygen want, a decrease in barometric pressure has other undesirable effects on the body. The symptoms are generally known as decompression sickness or dysbarism and may be classified according to whether they take place during ascent (decompression) or descent (recompression). They may also be grouped according to their cause: the expansion of free gases in certain body cavities from which ready escape is not always possible, causing pain in the abdominal region, sinuses or teeth; the escape of evolved gases, principally nitrogen, from solution in the blood and tissue fluids, giving rise to bends, chokes, and neurological symptoms. These latter disturbances, resulting from decompression from one atmosphere to less

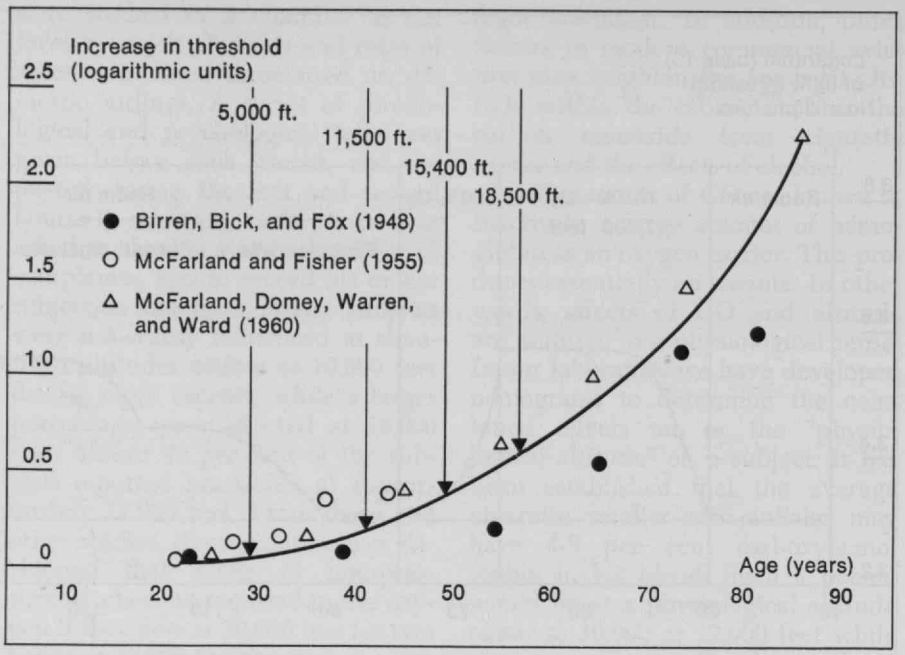
than one atmosphere are known as aeroembolism.

The first hazard in rapid decompression is that the pressure gradient is equalized rapidly and with great force. If an emergency hatch, or window fails, an individual near the opening might be swept out of the plane; such cases are on record in the early histories of both civilian and military operations.

A second hazard results from the direct effects of a very rapid rate of decompression. There are at least four important physical variables that must be considered: the volume of the pressurized compartment, the size of the opening, the pressure differential, and the flight altitude at which the decompression takes place. Naturally, the most drastic decompression possible would be that occurring in the smallest cabin with the lowest cabin altitude at the highest possible flight altitude. Experiments were made at Wright Field by Sweeney to test very extreme conditions in small military aircraft in flight at 35,000 to 40,000 feet. The results indicated that the average subject experienced a sense of inflation in the chest and abdomen as a result of expanded gas, and about 20 per cent of them suffered "bends" during the first 5 minutes at high altitude. These conditions were much more acute than would be experienced in transports with larger pressurized areas.

By far the greatest and most serious hazard of a rapid decompression is that of acute oxygen want, since useful consciousness can be maintained no longer than about one minute at 40,000 feet. This is an important consideration at all altitudes above 25,000 feet. A potentially more serious problem of acute oxygen want exists if a plane should be forced to remain at altitudes over 25,000 feet after loss of pressure because of weather or terrain below.

At very high altitudes, the time for the onset of symptoms is very rapid, and the effects on the body are extreme. The time of useful consciousness following cabin pressure failure at altitudes of 30,000-35,000 feet would be less than a minute or two depending on the age and physical condition of the passengers, the size of opening, and the volume of the cabin. Such tests as card-sorting and handwriting were used as criteria of the time of useful consciousness, using subjects in low pressure chambers following removal of their masks. The time reserve is 29 to 49 per cent longer in the mask removal than in the rapid decompression series. These latter findings are significant because they simulate more realistically the type of response that would occur during loss of pressure in an air transport in flight at high altitude.



In addition to the effects of oxygen want and aeroembolism, there are other variables that must be considered in high altitude flying. The effects of cold undoubtedly would be serious in some instances. Distention of the stomach and intestines might give rise to considerable distress, and persons with certain diseases of the heart or lungs, or with anemia, would experience severe reactions. One of the most common symptoms results from unequal pressure on the middle ear produced by a sudden change in pressure, and the effects can be very painful, sometimes involving a rupture of the eardrum.

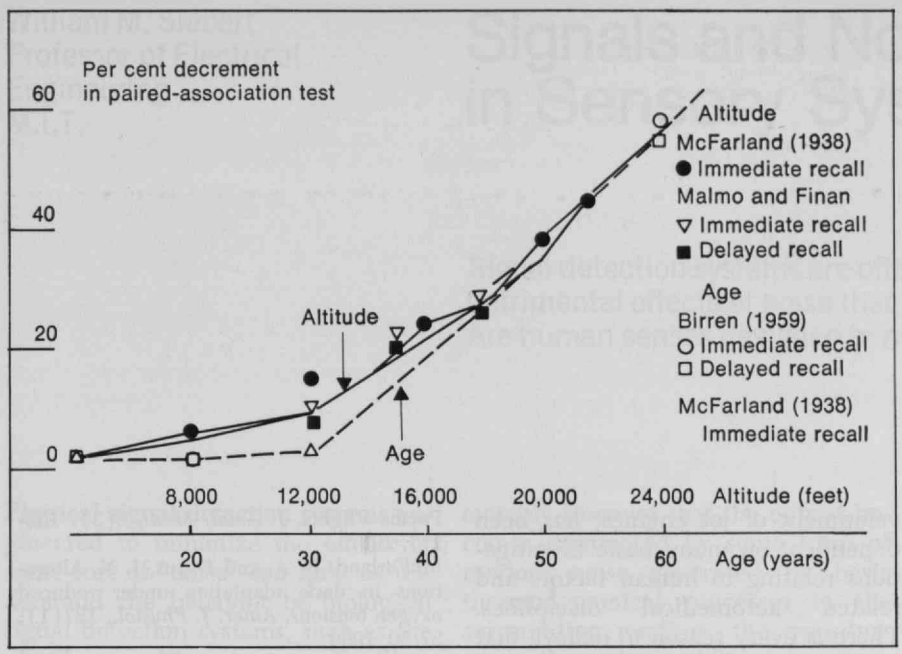
During World War II a great deal was learned about the loss of pressure in combat aircraft; indeed, many serious accidents occurred. For example, from August 1942 to May 1945, there were 388 non-fatal and 77 fatal cases attributable to oxygen want in the Eighth Air Force alone. During 1943 there were 21.6 deaths per 100,000 man missions. With improved indoctrination programs the death rate due to oxygen want declined to a level of 2 per 100,000 man missions by the end of the war.

The operating experience with pressurized air transports from 1950-1954 indicated that there was a sudden loss of pressure in one plane per 96,000 hours of flying. Most of these instances occurred below altitudes of 25,000 feet. In general, the number of rapid decompressions was less than anticipated.

In the very early days of operating air transports with pressurized cabins, there were several fatalities involving persons being "sucked out" of the aircraft. A navigator on a Constellation in the North Atlantic was ejected when his head struck the astrodome. Several cases of crew fatalities were reported due to ejections from cabin doors. In recent years, with the greater integrity of fuselage structures, the author is aware of no such cases.

Depressurization Incidents

An extreme instance of loss of pressurization occurred in 1966 during the flight of a B707 from McCord Air Force Base, Washington, to Tokyo when the aircraft, one hour before destination, experienced loss of cabin pressure at 39,000 feet. Emergency descent to 7,000 feet was made, with deployment of cabin oxygen masks. Two stewardesses lost consciousness while trying to help hypoxic passengers. The aircraft landed at Tokyo. Twenty passengers complained of ear pains and air-sickness; one passenger became unconscious and was amnesiac after regaining consciousness. Military physicians examined all 165 passen-



Increasing age or oxygen want impair both vision in dim light and performance on short-term memory tests, supporting the possibility that the effects of old age are caused by an inability of the body to transport or to utilize oxygen. The points in the graph at far left show the results of three series of vision experiments conducted on a total of 648 subjects, while the curve represents average values for the influence of increasing altitude on vision in dim light. The graph to the immediate left shows the similarity of impairments of memory caused by altitude and by increasing age.

gers; 135 were released and 30 were held for treatment of ear blockage. The cause of the depressurization could not be determined.

Although the records are quite incomplete, one gets the impression that there has been a decreasing danger of loss of cabin pressure. The author has recently had an opportunity to examine the records of cabin pressure malfunction incidents of one of the largest British operating airlines for the calendar year 1970. There was only one case reported in which the oxygen masks were released to the passengers. A large majority of the cases involved smoke or vapors in the cabin arising from compressor oil or blocked valves in the air conditioning system.

The structural integrity of current high altitude jet transports appears to be very high. For the most part, the incidents in recent years have been concerned with problems of door seals, with relatively fewer resulting from failures in compressors, ducts, and controls. In the few instances where cockpit windows have cracked, precautionary descents have been made, with no reports of sudden decompression due to complete loss of windows. Some instances have been related to poor maintenance or improper operation of the equipment.

It is relevant here to consider the investigations of the disastrous losses of two British Comet jet airlines on January 10 and April 8, 1954. Both aircraft disintegrated at high altitude shortly after takeoff. Using Gagge's very conservative estimate, it was shown that exceeding the limiting stress on the plane when flying at 30,000 feet (where cabin pressure is 7.5 lb./sq. in. above atmospheric pressure) would require the instantaneous loss of 154 square feet of cabin wall. According to Violetto's curve of limiting conditions, the actual area may have been 290 sq. ft.—a hole of 17 feet square. The extensive investigations which followed the Comet accidents, involving placing the fuselage in water, showed a strong probability that such a puncture actually took place. Much was learned from these very thorough and careful studies.

Cylinders and Masks

Anyone who has been associated with the use of oxygen stored in high-pressure cylinders is well aware of the dangers involved. When oxygen was first used for patients with cardiac and pulmonary diseases in hospitals, there were serious fires when patients, although strongly advised against doing so, lit a match for a cigarette in an oxygen-enriched tent. The tragic loss of the astronauts in the Apollo fire was traced to the increased inflammability of materials in an oxygen-enriched atmosphere. In addition, there are dangers of ignition during maintenance of equipment, and at least four large air transports have been totally destroyed during the installation of oxygen cylinders. One of the big fire hazards accompanying a crash landing is the possibility of the blow-torch effects of high-pressure oxygen exploding on impact.

In recent years, a great deal of experimentation has resulted in a new type of oxygen equipment for air transports. The industry is now changing to chemical oxygen (sometimes called solid-state or candle oxygen) which is typically produced from a combination process involving a chlorate "candle." The generators are installed in the seatbacks or overhead. Their flow-rates are not precisely predictable; they continue to yield oxygen for 20 minutes at a flow-rate of about 3.5 liters per minute per mask beginning ten seconds after actuation. The equipment occupies less than one-third of the space, and is about one-fifth the weight, of conventional gas cylinder systems. There may be some odor of chlorine, but this gas is filtered out and the oxygen is considered safe for humans.

The chemical oxygen generators have been installed on a number of air-bus type of transports, such as the USAF C5A, the L-1011, the DC-10, and the SUD-A 300B. The system was used for about 80 passengers in one compartment of a C5A cargo plane when a door seal failed at approximately 35,000 feet over Little Rock, Arkansas. It was a rapid decompression, and with deployment of the masks, the plane made a rapid descent without untoward incident. The wider use of such equipment in smaller and more conventional types of transports offers considerable promise, though application in

executive aircraft and other smaller general aviation planes is not as yet available.

The Climate for Altitude Studies

The safety record of the scheduled domestic and international air carriers is very favorable. However, there is no meaningful method of comparing the safety records of different forms of transportation because of the lack of a common denominator or baseline. On a worldwide basis, the fatality rate per 100 million passenger miles in 1970 was 0.28, and in 1971 was 0.35. The absolute number of passengers killed on scheduled services was 680 in 1970 and 859 in 1971. The only fatal accident in scheduled service (U.S.) during 1970 occurred on an international flight on December 28, 1970. In domestic operations in the U.S. no fatality occurred on scheduled routes in that year. This safety record appears to be a remarkable one in every respect.

It is interesting to note that jet air travel, especially with pressurized cabins, has also achieved an excellent record in regard to passenger comfort and safety. For the last 20 years the author has attempted to obtain the numbers of in-flight nonaccident deaths which have occurred on scheduled air transports. The rate of less than one passenger death per million revenue passengers has remained approximately the same in spite of the large increase in volume. In 1971, the world's scheduled airlines carried 325 million passengers. Undoubtedly the pressurized cabin has contributed to this enviable record.

In tracing the history and development of pressurized cabins, it has been possible to show how this design feature, furthered by the development of jet engines, has been dependent on many basic investigations relating to human factors and related aeromedical disciplines. There is every reason to believe that additional studies will be necessary to realize the greatest opportunity for this field of travel in the years ahead.

A more favorable climate now exists for research of this type and for the development of more effective health and safety programs. New concepts and new knowledge from the fields of aeronautical engineering, biotechnology, biostatistics, medicine, and psychology, for example, will provide fresh impetus for experimental studies. And there is increasing encouragement at higher levels of government for safety research in all forms of transportation.

Suggested Readings

Armstrong, H. G. The physiologic requirements of sealed high altitude aircraft compartments. Air Corps Tech. Rept 4165, 1935.

Bert, P. *Barometric Pressure. Researches in Experimental Physiology.* (1878) Translated from the French by M. A. and F. A. Hitchcock. Columbus, Ohio, College Book Co., 1943.

Bykov, L. T., Yegorov, M. S. and Tarasov, P. V. *High Altitude Aircraft Equipment.* London, Pergamon Press, 1961.

Flying Personnel Research Committee. Memorandum on Physiological Aspects of Pressure Cabin Developments, FPRC Rept #402, 1941, and Position in April, 1942, of certain flying equipment, pressure cabin aircraft, FPRC Rept #423, 1942.

Gillies, J. A. (Ed.) *A Textbook of Aviation Physiology.* London, Pergamon Press, 1965.

Harris, H. R. The flying steel tank. *New Frontiers,* 3(2): 9-10, Fall, 1955. (Garrett Corporation, Los Angeles, Calif.)

McFarland, R. A. and Forbes, W. H. The metabolism of alcohol in man at high altitudes. *Human Biol.,* 8(3): 387-398, 1936.

McFarland, R. A. and Edwards, H. T. The effects of prolonged exposures to altitudes of 8,000 to 12,000 feet during Trans-Pacific Flights, *J. Aviat. Med.,* 8(3): 156-177, 1937

McFarland, R. A. and Evans, J. N. Alterations in dark adaptation under reduced oxygen tensions. *Amer. J. Physiol.,* 127(1): 37-50, 1939.

McFarland, R. A. The Effects of Oxygen Deprivation (high altitude) on the Human Organism. Department of Commerce, Bureau of Air Commerce, Rept No. 13, May 1938. Reprinted as CAA Tech. Development Rept No. 11, 1941.

McFarland R. A. *Human Factors in Air Transport Design.* New York, McGraw-Hill, 1946.

McFarland, R. A. *Human Factors in Air Transportation—Occupational Health and Safety.* New York, McGraw-Hill, 1953.

McFarland, R. A. Experimental evidence of the relationship between ageing and oxygen want: In search of a theory of ageing. *Ergonomics,* 6(4): 339-366, 1963.

McFarland, R. A. Human Factors in Relation to the Development of Pressurized Cabins. *Aerospace Med.,* 12: 1303-1318, 1971.

William M. Siebert
Professor of Electrical Engineering
M.I.T.

Signals and Noise in Sensory Systems

Signal detection systems are often designed to minimize the detrimental effects of noise that unavoidably masks the signal. Are human senses designed to minimize similar problems?

Physical signal detection systems engineered to minimize the effects of some sort of "noise" can help us understand the behavior of biological signal detection systems, such as the visual or auditory system. To illustrate, let's explore some of the features of well-designed physical detection systems in some detail.

Suppose we are interested in designing a device to ring a bell or deflect a meter or make some equivalent discrete response to the presence of a specific weak physical stimulus (or signal) such as the earth vibrations due to a distant earthquake or the sonar echoes from a school of fish or the reflections of a laser beam from the moon. These stimuli are too weak and of the wrong character to produce the desired response directly, so we will need transducers and amplifiers.

How weak a stimulus could we detect in this way? What, in other words, is the *threshold of detection* for such a device? Naively, there would seem to be no limit; to detect a weaker signal all we apparently require is a stronger amplifier. But in practice, when we add more stages to increase the amplifier gain we inevitably discover that the output becomes dominated by some form of random noise generated by basic thermodynamical processes in the surrounding medium, the transducers, or the early amplifier stages.

This noise—apparently truly inescapable—has two major effects. First, the pressure of the noise sets fundamental limits on the smallest signals that can be reliably detected by our device. Second, when operating near this lower limit—or threshold—the behavior of the detection device becomes markedly erratic—occasionally and unpredictably the detector will not respond to stimuli that are present; occasionally and unpredictably it will give false alarms. If the detector is carefully designed, the pattern of these errors usually shows sufficient statistical regularity to permit a description of its erratic performance in terms of probabilities. As the signal is made steadily weaker, the error probabilities in general also steadily and continuously increase. Thus, the definition of threshold intensity for a physical detector is necessarily a statistical one. There is usually no sharply defined stimulus intensity at which performance suddenly and discontinuously goes from very good to very bad.

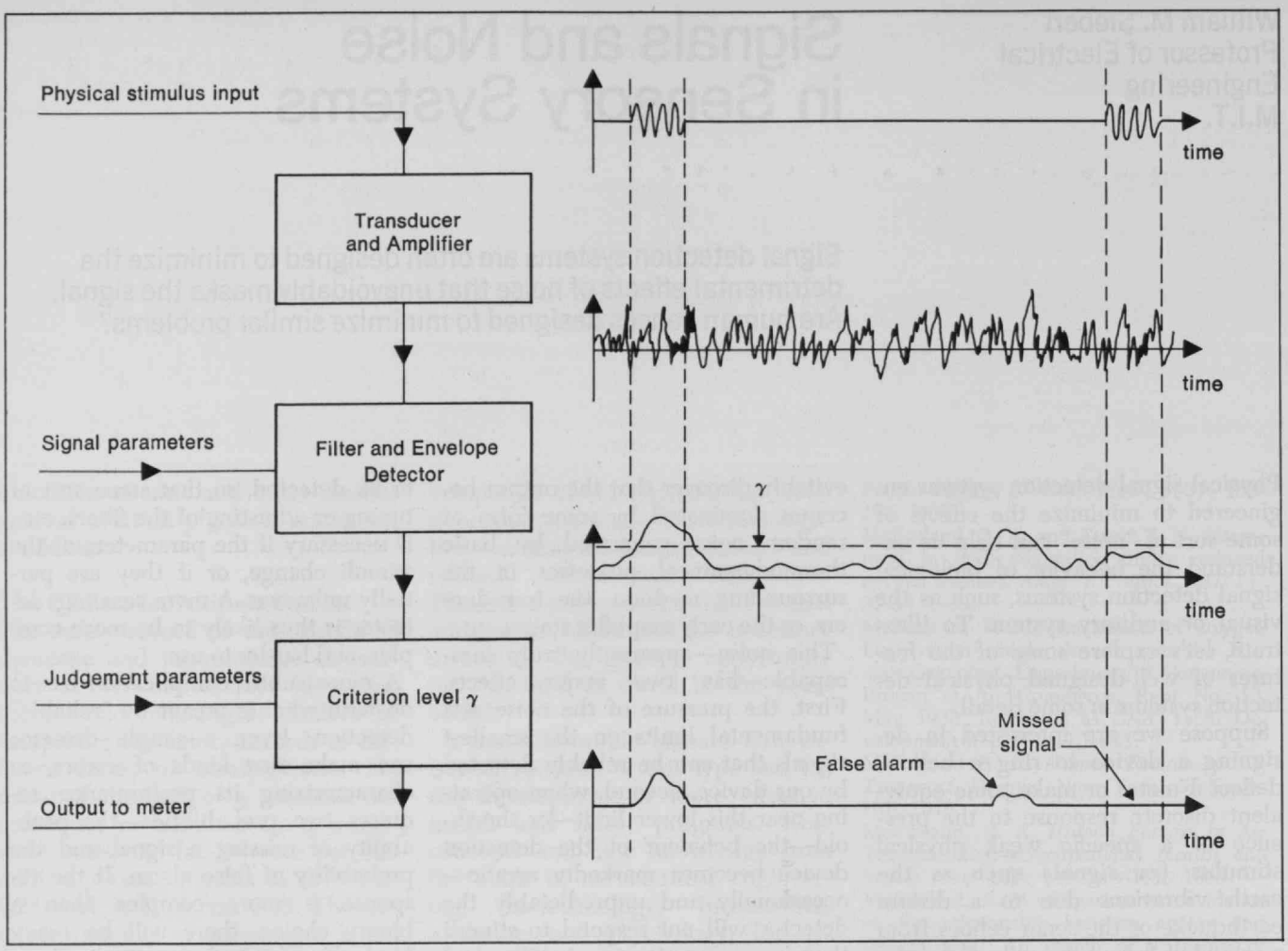
These noise effects have important consequences for the design and operation of sensitive stimulus detectors. It will, for example, generally be possible to process—to filter, integrate, rectify, etc.—the output of the amplifier in a way that will reduce the masking effects of noise. Obviously such processing is desirable if the sensitivity of the device is important. However, the appropriate kind of processing is often both elaborate and critically dependent on the character of the signal to be detected, so that some sort of tuning or adjusting of the filters, etc., is necessary if the parameters of the stimuli change, or if they are partially unknown. A more sensitive detector is thus likely to be more complex, and harder to use.

A more subtle complication has to do with what is meant by "reliable" detection. Even a simple detector can make *two* kinds of errors, so characterizing its performance requires two probabilities—the probability of missing a signal and the probability of false alarm. If the response is more complex than a binary choice, there will be many kinds of possible errors. Typically, a change in the detector which reduces the probability of one kind of error will increase the others.

How, then, are we to strike a balance? That would seem to depend upon an assessment of the relative costs of mistakes and the *a priori* probabilities that signals will be present. We require an explicit statement of the way in which these often nebulous quantities (we will call them "judgement parameters") determine the usefulness of a detection system if we are to complete the system design. This is where so many automatic or "computerized" systems break down. To be sure, the blame for an incorrect balancing of values should not be attributed to the amoral machine, but rather to the insensitive or incompetent human designer. But there's a bit more to it than that. Let me take an extreme example—the design of a missile-detecting radar for an A.B.M. system. Such devices must be automatic because the reaction time must be very short. But how is *anyone* to evaluate such quantities as the probability that a hostile missile will suddenly appear 1000 miles north-

---

William M. Siebert received both his S.B. (1946) and Sc.D. (1952) from M.I.T. in electrical engineering. His professional interests include statistical communication theory and communications biophysics. In recent years, he has become increasingly concerned with problems of biomedical education and research. This article is adapted from a paper delivered by Professor Siebert at the Sixth Annual Symposium on Some Mathematical Questions in Biology, held in December, 1971, in conjunction with the annual meeting of the American Association for the Advancement of Science. That paper will appear in Volume 5 of *Lectures on Mathematics in the Life Sciences*, published by the American Mathematical Society.



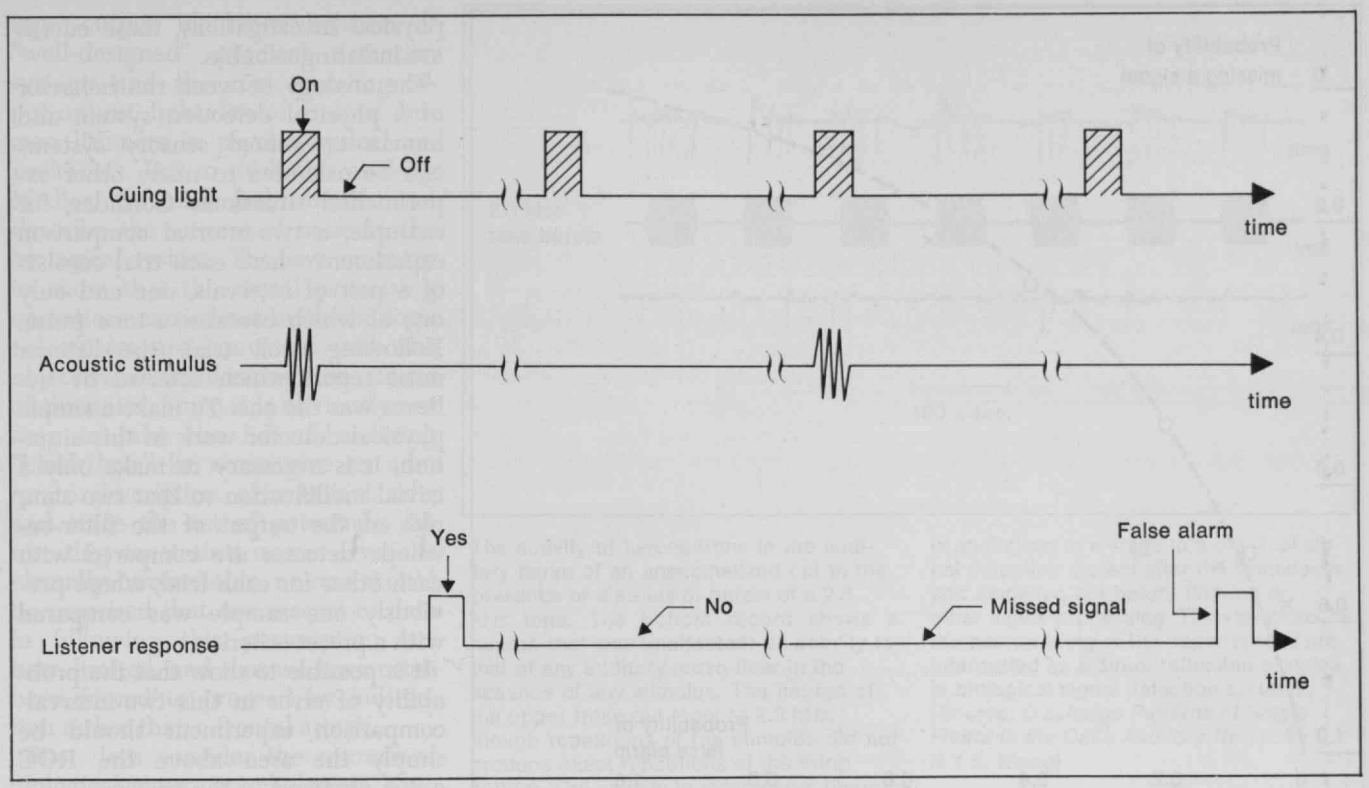
A system designed to detect the presence of a weak stimulus. The input is first amplified, which unavoidably introduces random fluctuations into the signal. In an attempt to minimize the debilitating effects of this noise, the signal is then processed in a manner that depends critically upon the character of the stimulus. In the final stage of detection, one quantity relates the probabilities of the two types of error—missed signals and false alarms—that the system can make. In this case, that "criterion level" is the level, γ, with which the signal intensity is compared. If the intensity of the processed signal exceeds γ, a meter deflects; the detector system is indicating that the stimulus is present. As γ is raised, the probability of false alarm declines toward zero, but the interrelated probability of missed signal rises toward one.

northwest from the radar at 9:00 o'clock tomorrow morning? Or balance the costs of the different kinds of errors such a system can make, taking into account—in advance and quantitatively—all the changing military, political, economic and social imponderables? No one is competent for such a task. And a military-political policy which seems to make our survival dependent on answering such questions obviously needs complete rethinking.

Fortunately, the situation is often simpler than this—particularly if the decision is a simple choice between two alternatives. If, by modifying the signal processing, we can reduce the probability of one kind of error without increasing the probabilities of any others, we should do so independently of how performance is evaluated. We shall call a system in which this process has been carried as far as possible (subject to whatever constraints are imposed) a *well-designed* system. For a well-designed system having just two kinds of errors, the entire impact of the judgement parameters is to determine an operating point along the curve that relates the two error probabilities. The net effect of these quantities (whatever their values and interactions) can consequently be represented by a single scalar quantity which we will call the criterion level. Even if we have no idea how the device is to be used and hence no idea of *a priori* probabilities and the costs of errors, we can still complete the design except for the value of the criterion, which can be left as a single knob to be adjusted as the user may wish. This is a substantial simplification.

The Inverse Problem

A well-designed simple physical detection device thus has a rather remarkable amount of organization. Suppose, now, that instead of trying to design such a device, we are faced with what is essentially the inverse problem—seeing what we can learn from studying a signal detector designed by someone else. The most direct question to try to answer is, of course, "How does it work?" But often a more interesting and important question is "What are the principles, constraints and objectives that guided the designer?" Because of the common structural features imposed by the noise on the design of all signal detectors, this is by no means an impossible task, although there are, to be sure, some very real difficulties. Just because, for example, we observe that one design parameter—the filter bandwidth—in



Deciding if one hears a tone is among the simplest tasks in human perception; studying that task is suited to our present abilities to understand. In this experiment, a tone is present in a random fraction of trials. Each trial period lasts about a tenth of a second, and is marked by the flashing of a cuing light. In the five-second interval between successive trials, the listener pushes a button if he believes the tone was present. Physical detection systems that perform similar tasks may teach us something about the biological detection system whose performance is tested here.

a detector is optimally matched to the duration of the signals to be detected does not imply that the bandwidth was chosen by the designer for this reason. Perhaps cause and effect were the other way around—the signals were chosen to match the filter. Alternatively, it is possible that the designer was ignorant of the proper value of the bandwidth, or considered the choice of little importance. Perhaps the whole device was constructed, with little or no thought, out of parts that just happened to be lying on the workbench. Perhaps the designer considered certain choices critical, but for entirely different reasons than those we have thought of. Short of direct communication with the designer, we can never be sure of his reasoning; our arguments remain only a theory. But if many aspects of the device show consistent evidence of being a "good design," our theory is likely to be an interesting one.

The study of the sensory detection systems of humans and other animals is a problem of this inverse type. To a physicist, the fundamental question about any system is likely to be "How does it work?" But to a biologist, the more important question about a living system is likely to be "Why does it work that way?" In recent years, enough has been learned about the structure and behavior of at least some sensory systems—we have proceeded far enough in answering the physicist's question of "how"—that we can begin to explore the biologist's question of "why" on the basis of facts rather than conjecture.

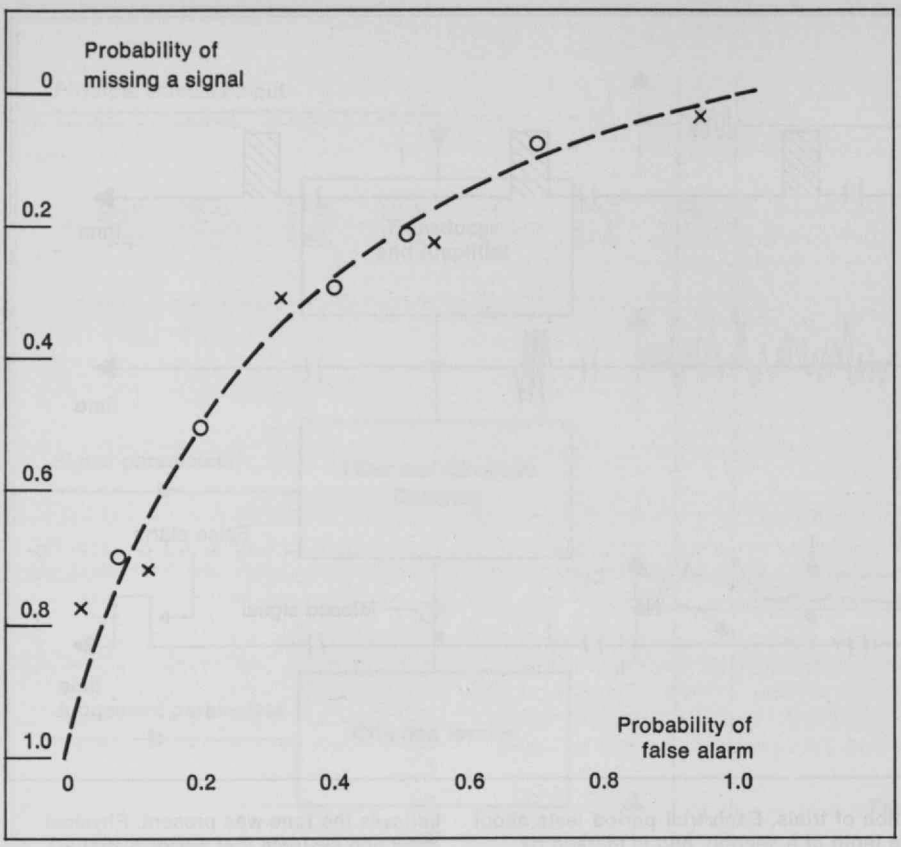
In these explorations of sensory detection systems, an analogy with "well-designed" physical signal-detection systems is, I believe, crucial. To be sure, we understand little of evolutionary processes, so there are obvious dangers in thinking about living systems in terms of purposeful design: we have learned to be suspicious of teleological arguments in biology as well as physics. Still, the analogy between sensory systems and well-designed physical systems is, as we shall see, so close that it becomes, I think, an interesting and potentially productive theory.

To suggest that human beings behave like machines runs the risk of alienating even further those who are already depressed by the dehumanizing forces of modern technology. But one does not have to buy the whole of Skinnerian psychology to agree that there are many ways in which human behavior appears rather mechanical. No doubt these ways are the least interesting aspects of behavior, but they are also the simplest—and thus they are suited to our presently very limited capacities to probe and understand.

Human Sensory Behavior

Let us then begin by exploring some of the overall behavioral respects in which a human sensory detection system mimics physical detection systems of the sort we have discussed. The first scientist to study sensory performance systematically from this point of view was probably L. L. Thurstone. More recently, this approach has been associated with the names of W. P. Tanner, J. A. Swets, and D. M. Green, among many others.

Consider specifically this simple auditory experiment: A human listener in a quiet room attempts to decide in each of a succession of intervals a few seconds apart (the intervals may be marked by a cuing light) whether a sound is present or not. If present, the sound is a pulsed tone of fixed frequency, fixed dura-



The interrelationship of the probabilities of missing signals or giving false alarms in an experiment in which a listener is asked to press a button if he believes he hears a sound. The crosses represent changes in performance when the rewards and penalties are changed. The circles represent changes obtained when the fraction of trials containing the sound is changed, thus altering the frequency of opportunities to make either type of error. The curves are indistinguishable, within the precision of psychophysical experiments. Thus, as in a well designed physical detection system, both types of change simply shift an operating point along the curve relating the two error probabilities.

tion (say 0.1 sec), and fixed intensity. Signals are present in a random fraction, p, of the intervals, or trials. If the listener decides that the tone is present on a given trial, he depresses a button during the time before the next interval.

Typically, a listening session begins with a training period during which the intensity of the sound is progressively lowered until the listener begins occasionally to fail to detect it. At the same time, typically, he will occasionally report signals when they are not present. "Good" trained listeners reach a limiting performance level after a training period (in which the sensory detection system is presumably adjusting to the particular stimulus being used). In this limiting condition, their performance is well-described as a random process. Errors of both kinds—false alarms, and missed signals—are made, and the pattern of errors appears to be largely unrelated to either the pattern of stimulus presentations or the pattern of previous responses.

We have seen that for a well-designed physical detection system, changing the fraction, p, of trials containing signals and changing the relative costs of errors are equivalent, since any changes are reducible to turning the knob that varies the criterion level, as described earlier. The sole effect of either change is to shift the operating point along a curve relating the error probabilities. Experimentally, an analogous result holds for human listeners. In the graph on this page, the crosses represent the relation between the probabilities of false alarm and missed signal (called a *receiver operating characteristic* or *ROC* curve) obtained in an auditory detection experiment when the relative costs of errors are changed, while the circles describe the *ROC* curve induced by changes in the relative frequency p of signal presentations. Within the precision to be expected in psychophysical investigations, these curves are indistinguishable.

The analogy between the behavior of a physical detection system and human or animal sensory systems can be extended to many other experimental situations. Consider, for example, a two-interval comparison experiment where each trial consists of a pair of intervals, one and only one of which contains a tone pulse. Following each trial, the listener must report which interval he believes was the one. To make a simple physical detector work in this situation, it is necessary to make only a trivial modification so that two samples of the output of the filter-envelope detector are compared with each other for each trial, where previously one sample was compared with a preset criterion.

It is possible to show that the probability of error in this two-interval-comparison experiment should be simply the area above the ROC curve obtained in the previously described "yes-no" experiment for the same stimulus intensity. Psychophysical experiments prove that this same result also correctly describes the performance of human listeners—one of the very few cases in experimental psychology in which performance in one experimental paradigm predicts with precision performance in a different paradigm.

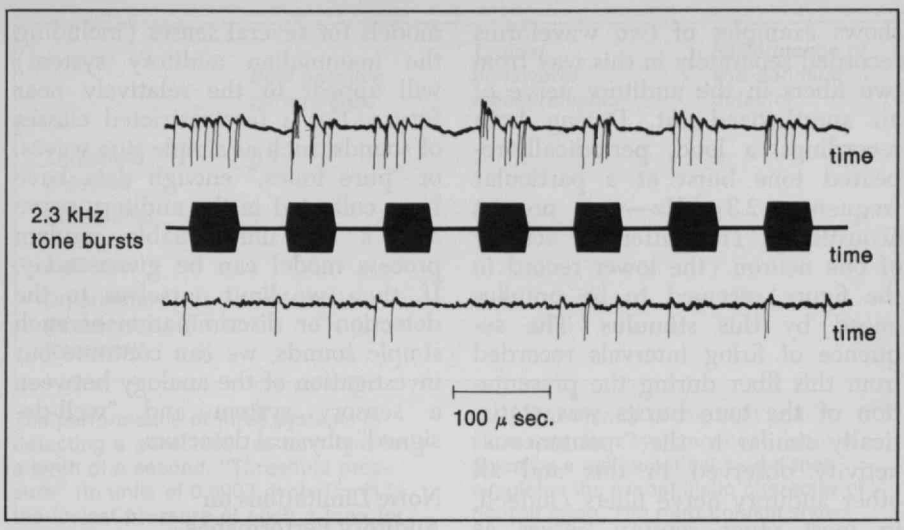
The two-interval comparison experiment procedure is not limited to exploring the threshold situation in which one interval contains the signal and the comparison interval silence. We may, for example, present the same loud masking waveform in both intervals with an additional desired signal added only in one; in this case the amplitude of the desired signal that can be reliably located (say 75 per cent of the time) is called the masked threshold for that signal and masking waveform. Alternatively, both intervals may contain signals, one of which is stronger, or longer in duration, or higher in frequency, than the other. Again, for small differences, the behavior of trained listeners is probabilistic; the difference that can be correctly discriminated 75 per cent of the time is called the differential threshold for that parameter.

The Sources of Biological Noise

All these experiments, as well as many others, suggest that there is a strong analogy between at least the

input-output "black-box" behavior of "well-designed" physical detection systems and the corresponding input-output behavior of trained human listeners in psychophysical experiments. But to push this analogy further, we must first identify and describe the sources of noise in the biological system. Then we must try to show that the signal processing operations carried out by the biological system are consistent with the objective of minimizing the effects of the noise. Since it is obviously not easy to take the lid off a living "black box," let alone give an adequate description of what's inside, and since the set of potentially interesting constraints on our senses is virtually uncountable, no one should be surprised that our success to date in following this prescription has been limited, and that we have often been forced to proceed by indirection rather than a frontal attack.

First, let's consider the sources of biological noise. Psychologists have been reluctant, no doubt for at least partly professional reasons, to admit that the dominant noise source might be inside the organism. They have frequently argued that the basic cause of random behavior is fluctuation in the stimulus, either as a result of natural mechanisms (such as quantum effects and Brownian motion) or noise incidentally or intentionally introduced by the experimenter (perhaps with the hope of swamping any effects of internal noise sources). The fact that human and animal senses seem to be remarkably keen has reinforced this belief. Calculations and experiments, however, show that fluctuations in the physical stimulus may be important in a few senses (e.g., vision and smell) in the immediate vicinity of the threshold of detection, but they are unlikely to be the principal noise phenomena in other senses. Moreover, differential thresholds at moderate and high intensities are influenced by the effects of noise as much as, or more than, absolute thresholds. To explain these observations for any sensory system in terms of stimulus fluctuations requires unconvincing ingenuity. Even intentionally adding noise to the physical stimulus cannot guarantee that the dominant noise is external, since the effects of internal biological noise are not in general additive. If fluctuations in the physical signal cannot in general account for the probabilistic behavior of sensory systems, then we must look inside the organism for noise sources.



The activity of two neurons in the auditory nerve of an anaesthetized cat in the presence of a series of bursts of a 2.3 kHz tone. The bottom record shows a neuron that was unaffected; its activity is that of any auditory nerve fiber in the absence of any stimulus. The neuron of the upper trace did react to 2.3 kHz, though repetitions of the stimulus did not produce exact repetitions of the firing pattern. The activity in these nerve fibers is analogous to a stage in a physical signal detection system after the transducer and amplifier, but before filtering or other signal processing. The variations in the neuron firing of the upper record are interpreted as a direct reflection of noise in biological signal detection systems. (Source: *Discharge Patterns of Single Fibers in the Cat's Auditory Nerve*, by N.Y.S. Kiang)

Most sensory systems share certain organizational features. There is usually a mosaic of sensory cells, or receptors, which collectively play the roles of both transducer and, in part, amplifier. The information picked up by the receptors is conveyed to more central parts of the nervous system by a sensory nerve containing many individual nerve fibers, or neurons. The relation between receptors and nerve fibers, however, is rarely one-to-one. Generally, a local cluster of receptors interacts both spatially and temporally in complex ways (sometimes through auxiliary nerve cells) to influence each nerve fiber.

Nerve cells convey information from one point to another by means of chemically generated voltage spikes—called neuron firings or action potentials—that propagate along the axon, the output fiber of a nerve cell, at a constant velocity that is typically tens of meters per second. Unlike the propagation of an electromagnetic wave along a transmission line, the mechanism of nerve propagation is an active process involving continuous regeneration of the action potential as it travels. As a result, the amplitude of an action potential is almost completely determined by the properties of the nerve fiber; spike amplitude cannot be modulated to convey information about a sensory stimulus. The information carried by a nerve fiber is believed to be entirely encoded in the durations of the intervals between the firings, which can be as short as a fraction of a millisecond. These durations remain relatively uncorrupted by transmission through the nervous system. Thus the receptor which converts sensory stimuli into time patterns of action potentials can be considered to function as both transducer and amplifier.

Physiological evidence for randomness or noise in sensory-neural systems is not at all difficult to find. In particular, the firing pattern induced in a sensory nerve by a repeated stimulus usually varies erratically in at least some details from one repetition to another. An example will help make this phenomenon clearer, as well as allow us to explore its possible significance.

Information Coding in Auditory Nerve Fibers

In recent years, it has become possible in several sensory systems to monitor the patterns of activity in the sensory nerves under a variety of stimulus conditions, by positioning near a neuron an electrode connected to an amplifier and oscilloscope. The illustration on this page

shows examples of two waveforms recorded separately in this way from two fibers in the auditory nerve of an anesthetized cat. During both recordings, a loud, periodically-repeated tone burst at a particular frequency—2.3 kHz—was present acoustically. The pattern of activity of one neuron (the lower record in the figure) seemed to be uninfluenced by this stimulus. The sequence of firing intervals recorded from this fiber during the presentation of the tone bursts was statistically similar to the "spontaneous" activity observed in this and all other auditory nerve fibers (indeed, in most other sensory nerves as well) in the absence of any stimulus.

But the other fiber showed marked changes in its response pattern (the upper record) when the periodic tone burst sequence of 2.3 kHz was present. The total firing rate increased, and spikes tended to occur during the fraction of the period that the tone burst was actually "on." Similar changes were evoked in the lower fiber by using a different tone-burst frequency (near 6.6 kHz, in this case); at this frequency the upper fiber showed little effect of the stimulus.

Dramatically, even though a rather strong stimulus was used in these experiments, repetitions of the stimulus did *not* produce repetitions of the detailed firing pattern, either in the timing or in the total number of firings (which varied from five in response to the sixth pulse to about 10 in response to the fourth). We interpret this variation as a direct reflection of "noise" present in some earlier stage of the system—presumably in or near the transduction mechanism.

The pattern of activity in the auditory nerve can be specified by a vector, **t**, whose components are the complete set of times at which action potentials occur in all the tens of thousands of fibers in the nerve. A complete random-process description of the behavior of the auditory nerve requires that we be able to describe the joint probability density of **t** for an arbitrary acoustic pressure waveform at the ear drum. Obviously, this is a tall order. No one to date had devised even a rough approximation to such a complete statistical description for any sensory system, although the rate of progress in this field makes it conceivable that reasonably complete first-order models for several senses (including the mammalian auditory system) will appear in the relatively near future. For a few restricted classes of sounds, such as simple sine waves, or "pure tones," enough data have been collected in the auditory nerve that a not unreasonable random process model can be given today. If, then, we limit ourselves to the detection or discrimination of such simple sounds, we can continue our investigation of the analogy between a sensory system and "well-designed" physical detectors.

Noise Limitations on Auditory Performance

Observation of the activity in all fibers of the auditory nerve corresponds to observation of the signal at the output of the transducer-amplifier in a "well-designed" detection system, prior to all or most of the noise-reducing filtering or signal processing. Very little is known about the details of the signal processing of auditory nerve patterns that is carried out in more central parts of the nervous system. The experimental problems are enormous. Nevertheless, because we do know something about the overall behavior of the auditory system from psychophysical studies of the type we have described, and because we can say quite a lot (at least for certain simple sounds) about the auditory input carried by nerve fibers to the central nervous system, we may be able to infer some of the properties of this system.

For example, we can use standard statistical tools to derive certain limits on the detection and discrimination performance of the auditory system implied by the probabilistic nature of the auditory nerve input. If actual behavior approaches these limits, then the analogy we have been drawing between the auditory system and a physical system "well-designed" to combat the effects of noise is neatly reinforced. If, on the other hand, actual auditory performance is significantly inferior to the best possible performance implied by the random character of the auditory nerve patterns, then we have learned much less. Conceivably, evolutionary pressures have not been strong enough to achieve an optimum realization. Perhaps the necessary operations are just too difficult for neurons to carry out, or the particular tasks we have studied are not important enough to "survival"; or the needed operations are in conflict with those required for some more important behavior. Perhaps our whole approach is just too simple-minded. Even so, we may be lucky: the ways in which the actual system fails to be optimum may have a pattern to them from which we can conjecture about the way the central system functions.

The procedure described in the preceding paragraph has been carried out for the absolute threshold of a pure tone and for the differential threshold in intensity and frequency of a tone. The first two columns of the table on page 29 show the results and the corresponding typical behavioral limits of human listeners.

The comparison is disappointing. The performance of the actual system does not even approach the theoretical limits, except possibly for the differential threshold in intensity. Moreover (although this is not shown in the table), the dependence of actual psychophysical performance on the duration, intensity, and frequency of the stimulus is markedly different from that of the theoretical limit—again with the possible exception of the differential threshold in intensity.

We must conclude, therefore, that the central auditory system fails significantly to make optimal use of all the relevant information conveyed by the fibers of the auditory nerve—even in such apparently basic and straightforward tasks as detection and discrimination of tone bursts. Careful analysis of the structure of decision rules achieving optimum performance suggests that the discrepancy between actual and best-possible behavior is greatest in those cases (such as frequency discrimination) in which the optimum detector makes extensive use of the detailed timing of the firing patterns of the auditory nerve fibers.

It is not difficult to suggest mathematical descriptions of detector systems that come much closer to mimicking actual psychophysical performance, at least for this class of tasks. Perhaps the simplest constrains the central auditory processes to use only that information conveyed by which nerve fibers have been relatively active over a fixed short interval of the past. The process ignores all other details of firing pattern activity. The analysis then yields the results shown in the third column of

the table at right. Quantitatively, this non-ideal process is much closer in its performance to the actual system. Qualitatively also, it can be shown that the dependence of this detector on the stimulus parameters is more realistic.

In spite of the close parallel between the performance of this non-ideal detector and the performance of human listeners over a wide range of stimulus parameter values and for different discrimination and detection tasks, we cannot conclude that the human nervous system in fact exploits only those aspects of the auditory nerve patterns related to which fibers are active, and ignores the detailed timing patterns of the fiber activity. The basic limitation could well turn out to be "noise" introduced not in the transducing and amplifying stages, but in the central nervous system's signal processing. But the success of this simple detector model in mimicking reality is at least intriguing.

	Best possible performance	*Typical behavioral measurements*	*Performance of sub-optimum detector*
Threshold pressure	0.1	2	2
Differential threshold pressure	1	5	1
Differential threshold frequency	0.01 Hz.	2 Hz.	.7 Hz.

The performance of three systems in detecting a pure 1000 hz. tone that lasts a tenth of a second. "Threshold pressure" (in units of 0.0002 dynes/cm^2) is the lowest pressure of such a tone for which it can be reliably detected on three quarters of the occasions when it is present. Similarly, the differential thresholds for pressure (in units of 0.0002 dynes/cm^2) and frequency (in hertz) indicate the mimimum differences in each that can be reliably detected three quarters of the time if the sound pressure level is 0.02 dynes/cm^2. The first column shows the performance of the best possible detection system whose input is given by a mathematical model that simulates the probabilistic character of neuron firing. The third column shows the performance of a sub-optimum system that uses only the information conveyed by which neurons have been relatively active over a fixed short time interval. The middle column shows typical human performance. The sub-optimum system mimics that performance more closely than does the best possible system.

The Signals of Knowledge

The probabilistic character of stimulus representation in the pattern of auditory nerve activity sets limits on the ability of the auditory system to detect weak sounds or to discriminate between nearly identical sounds. A system designed to attain these limits would, moreover, show much of the behavior that we find in "well-designed" physical detection systems. But in two major respects, the performance of the actual auditory system differs from that of a system designed optimally to minimize the effects of noise:

☐ Quantitatively, the performance of the actual auditory system is markedly inferior to that of the best possible system.

☐ Qualitatively, the dependence of actual performance on stimulus parameters is different from that of the optimum system.

The discrepancies of both kinds are significantly reduced if one postulates that the central parts of the auditory system are essentially optimum except for an inability to exploit the information in the detailed timing of nerve firing patterns.

To be sure, nothing in our argument precludes the possibility that "noise" introduced more centrally—perhaps in the memory process—is in fact the real limitation on auditory performance, even in the simple detection and discrimination situations discussed here. All we have shown is that behavior in these tasks is consistent with the assumption that the auditory system is "well-designed" (within certain constraints) to minimize the limitations imposed by the stochastic character of the auditory nerve activity.

As any biomathematician will tell you—sometimes with a touch of despair—"noise," or variability, is an important characteristic of all biological activity. But variability is not only a nuisance to the biological scientist; it must be a nuisance to the biological organism as well. The intricate arrangements necessary to life at all levels cannot function if noise dominates the signals. Methods for reducing probabilistic effects thus should have survival value, and noise reduction ought to be an important evolutionary principle—one that may, I think, tell us a great deal about why living systems are structured the way they are. As we learn more, we will have more and more need for such principles to organize our facts and guide our further studies—if the signals representing biological knowledge are not themselves to become lost in a clutter of unassimilated observations.

Suggested Readings

Thurstone, L. L., A law of comparative judgment, *Psychol. Rev., 34,* 273-286, 1927.

Thurstone, L. L., Psychophysical analysis, *Am. J. Psychol., 38,* 368-389, 1927.

Swets, J. A. (ed.), *Signal Detection and Recognition by Human Observers, Contemporary Readings,* John Wiley & Sons, Inc., New York, 1964.

Green, D. M. and Swets, J. A., *Signal Detection Theory and Psychophysics,* John Wiley & Sons, Inc., New York, 1966.

Harris, G. G., Brownian motion in the cochlear partition, *Jour. Acoust. Soc. Am., 44,* 176-186, 1968.

Hecht, S., Shalaer, S., and Pirenne, M. H., Energy, quanta, and vision, J. *Gen. Physiol., 25,* 819-840, 1942.

Fitzhugh, R., A statistical analyzer for optic nerve messages, *J. Gen. Physiol., 41,* 675-692, 1958.

Werner, G. and Mountcastle, V. B., Neural activity in mechano-receptive cutaneous afferents: stimulus-response relations, Weber functions and information transmission, *J. Neurophysiol., 28,* 359-397, 1965.

Tasaki, I., Nerve impulses in individual auditory nerve fibers of guinea pig, *J. Neurophysiol., 17,* 97-122, 1954.

Kiang, N. Y. S., Watanabe, T., Thomas, E. C., and Clark, L. F., *Discharge Patterns of Single Fibers in the Cat's Auditory Nerve,* M.I.T. Res. Monograph No. 35, M.I.T. Press, 1965.

Parzen, E., *Stochastic Processes,* Holden-Day, San Francisco, 1962, p. 124.

Johnson, D. H., Statistical relationships between firing patterns of two auditory nerve fibers, S. M. dissertation, Department of Electrical Engineering, M.I.T., Cambridge, Mass., 1970.

Cramer, H., *Mathematical Methods of Statistics,* Princeton University Press, Princeton, 1946, sec. 32.3.

Siebert, W. M., Stimulus transformation in the peripheral auditory system, in *Recognizing Patterns* (P. A. Kolers and M. Eden, ed.) M.I.T. Press, Cambridge, Mass. 1968.

Siebert, W. M., Frequency discrimination in the auditory system: place or periodicity mechanisms?, *Proc. IEEE, 58,* 723-730, 1970.

John E. Huguenin,
Woods Hole Oceanographic Institution

Living and Working in the Sea: A Status Report

The most common commercial method for undersea work still uses, after more than 100 years, the Siebe "hard hat" diving dress and its modern derivatives. The diver usually wears a closed helmet and weighted boots, which give him bottom traction but make swimming difficult.

The success of the traditional technique has been due to its simplicity and reliability, and to the diver's ability to operate on the bottom much as he would on land, albeit at a slower pace. He normally is at nearly neutral buoyancy but is able to control his buoyancy enough to easily remain standing (in an outfit that may weigh more than 200 lbs. in air). He can use most common hand tools such as wrenches, screwdrivers, and crowbars. The diver also has good communication with the surface through telephone wires in the gas hose, which may carry other services such as electric power and heated water for body warmth.

The major limitation of the Siebe technique is the diver's gas hose, which restricts mobility and can become fouled around obstructions, especially in the presence of currents.

Most diving research has been directed at finding gas mixtures to satisfy the primary requirement of sustaining life at elevated pressure. By and large, this work has been empirical. Little effort has gone into determining man's capabilities at depth once "safe" mixtures and techniques have been found.

A post-World War II development is the popularity of the self-contained underwater breathing apparatus (SCUBA), which provides on demand compressed air at ambient pressure and usually is used by neutrally buoyant free-swimming divers equipped with swimming fins. The SCUBA's advantages are reliability, the flexibility provided by its being self-contained and portable, and its use of ordinary air. Its greatest value is in survey and search tasks. Prior to the air SCUBA most self-contained units used pure oxygen and were limited to about a 30-ft. safe-depth due to the toxicity of oxygen at greater pressures; their primary value is military since they do not normally release noisy and observable bubbles.

But the advantages of a free-swimmer can become liabilities, particularly in water of poor visibility and appreciable currents. Here the free swimming diver is likely to have trouble navigating and maintaining body positions; indeed staying in one place may not be easy. He also has difficulty exerting forces and torques on fixed objects because of his lack of traction. So for many tasks, free-swimming is not the technique of choice.

Going Deeper, Staying Longer

The ability to work effectively in the sea has improved rapidly in the past 10 years. In general, advances have come through adapting and modifying approaches, techniques, materials, and subsystems developed mainly in aerospace and military programs. The increased effort has been spurred by at least two motivations: the growing strategic importance of the undersea domain and the resource potential of the world's oceans and seabeds. Incidents involving the nuclear submarine *Thresher* which sank off New England in 1963, and the accidental loss of a hydrogen bomb off Palomares, Spain, in 1966 demonstrated the inadequacies of the techniques and equipment then current. While neither operation depended on the use of divers, the focusing of attention on the problems and limitations of working in the sea has stimulated diving science and technology. Progress since these events in terms of depth reached by divers and time spent there has been spectacular (see illustration on p. 31).

The requirements for great depth and endurance have imposed two serious limitations on self-contained breathing units. One is that such open-cycle diving systems as the compressed-air SCUBA suffer a drastic reduction in endurance with increased depth. Ordinary air breathed at the ambient pressure makes its single pass through the lungs at a high density but oxygen is extracted from it at approximately the normal rate; the unused oxygen is expelled, a total waste. At a depth of 300 ft., for example, where the pressure is 10 atmospheres, an air supply good for 100 min. at the surface lasts about 10 min. Semi-closed breathing systems employing some re-use of exhaled gases have served as an interim extension of diving capabilities. Potentially the best approach is the completely closed-cycle system, whose oxygen is supplied at the needed density whatever the pressure, thereby making endurance independent of depth. But this system encounters the second major limiting factor: the engineering problems of reliably

As a Research Associate at Woods Hole **John E. Huguenin** is engaged in systems engineering and evaluation of potential large-scale marine agriculture operations. His degrees include an Ocean Engineer degree and an S.M. in ocean engineering at M.I.T. (1970), an M.S. in aerospace engineering at the University of Southern California (1967), and a S.B. in aeronautics and astronautics at M.I.T. (1964). This article is an outgrowth of work done while at M.I.T.

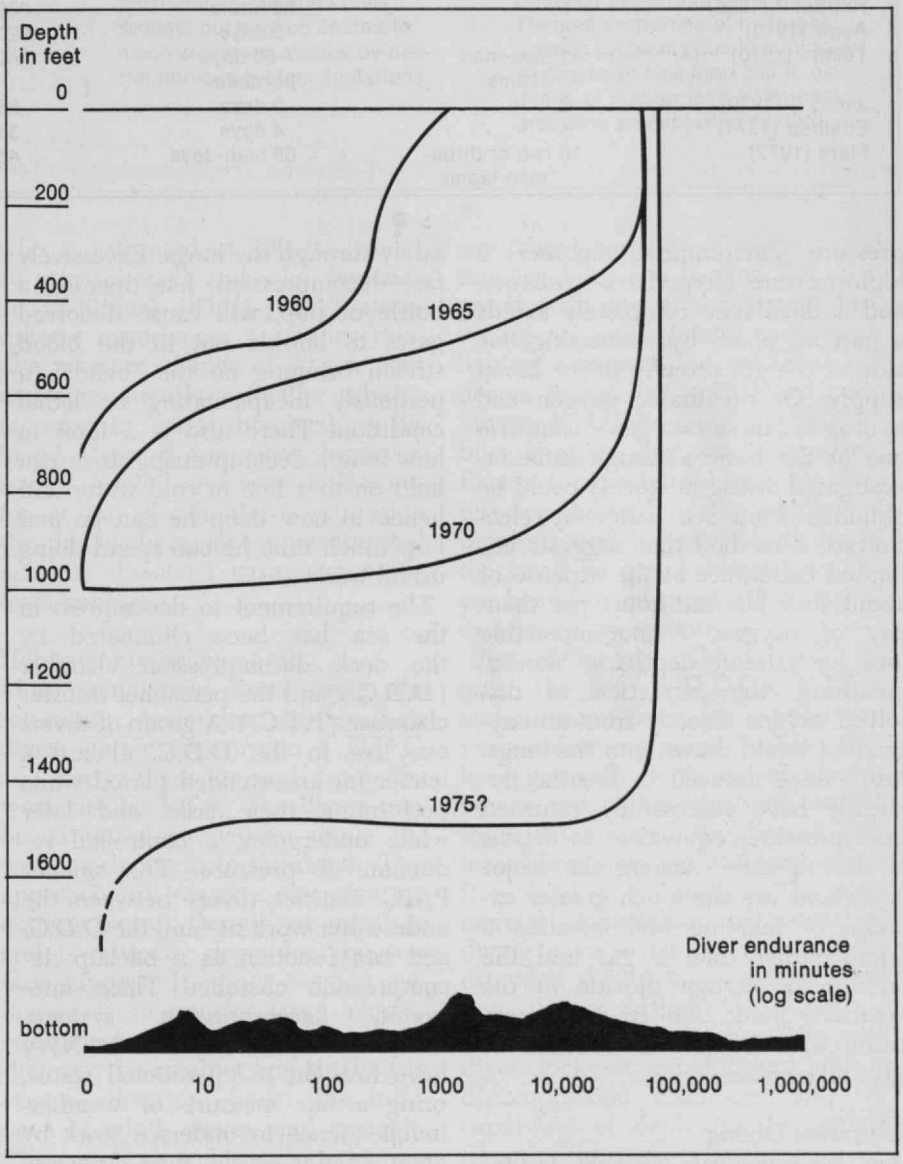
Our undersea capabilities have grown dramatically in the past decade, but their commercial application has been limited to offshore oil operations. In the coming decade further development of diving gear will be mainly in the petroleum industry and military areas while habitat activities will be confined largely to scientific programs.

monitoring and controlling the gas mixture in a closed system.

Because of these limitations and because in most situations the need for mobility is minimal many undersea work systems continue to use a tethered-hose ("hookah") breathing system with the gas mixture coming from either a nearby undersea habitat or a support vessel. The support facility provides a suitable location for monitoring and control equipment, which can be highly redundant for the sake of reliability and which can provide much more safety and endurance than is currently possible with most portable self-contained systems. But tethered divers are restricted by the length of the hookah line and by the danger of fouling it (a hazard in the Sealab II project due to poor visibility and the profusion of objects, cables, and projections around the habitat).

For the future, self-contained, closed-cycle, mixed-gas breathing systems can nevertheless be expected to achieve long endurances with high reliability and safety. Several promising new closed-cycle systems are available. Marine biologists in Tektite II and other projects have found that the absence of noisy bubbles in these systems permits unobstrusive observation of marine animals. Replacement of today's high-pressure gas tanks with cryogenic storage may further increase endurance or alternatively reduce the size of the backpack.

In the more distant future, it is conceivable that membrane diffusion will be used to extract a breathable mixture directly from the sea—a kind of artificial gill. Several different approaches to artificial gills are under investigation, some of which have been tested with small animals. One type provides a 1-atmosphere



The maximum state of the diving art has advanced considerably since 1960. This figure indicates what was and is possible, not necessarily what has been accomplished. Using the saturation diving technique, the individual may remain at ambient pressure for long periods since decompression time does not increase once the blood and tissues are saturated with the gases of the breathing mixture.

Saturation Diving/Habitat Experiments in the Sea

Project	Divers	Diving Time	Saturation Depth (ft.)	Gas mixture
Man-in-Sea (1962)	1	24 hours	200	97% He_2, 3% O_2
Conshelf 1 (1962)	2	7 days	34	Air
Conshelf 2 (1963)	5	1 month	31	Air
	2	7 days	85	75% He_2, 25% Air
Man-in-Sea (1964)	2	49 hours	432	96.4% He_2, 3.6% O_2
Sealab I (1964)	4	11 days	192	He_2, O_2
Sealab II (1965)	3 ten-man teams	15 days per team	204	75% He_2, 20% N_2, 4% O_2
Conshelf 3 (1965)	6	4 days	82	93.5% He_2, 6.5% O_2
	6	22 days	328	97.9% He_2, 2.1% O_2
Janus I (1968)	2	6 days	300	97% He_2, 3% O_2
	2	6 days	500	98% He_2, 2% O_2
Tektite I (1969)	4	60 days	43	92% N_2, 8% O_2
Helgoland (1969)	4	10 days	64	Air
Habitat II (1969)	5	60 hours	200	He_2, Air
Aegir (1970)	6	5 days	520	91% He_2, 7.2% N_2, 1.8% O_2
Tektite (1970)	11 five-man teams	7-30 days per team	40	91% N_2, 9% O_2
Janus II (1970)	6	5 days	660	98% He_2, 2% O_2
Edalhab (1971)	3	4 days	33	Air
Flare (1972)	10 two or three-man teams	68 man-days	45	Air

These representative habitat projects (there have been many more around the world) suggest the directions of diving and habitat development. Since the death of a diver in 1969 and the cancellation of Sealab III, habitat experiments have concentrated on exploitation of proven technology at shallow depths for scientific research.

pressure environment, another a high-pressure (hyperbaric) mixture, and a third type completely avoids a gaseous phase by connecting one side of the gill directly to the blood supply. Or breathable oxygen and hydrogen (these two gases comprise one of the basic although little investigated diving mixtures) could be obtained from sea water by electrolysis, a method that suggests unlimited endurance at the expense of about four kilowatt-hours per man-day of oxygen. A not-impossible idea for extreme depths is "fluidic" breathing, the extraction of dissolved oxygen directly from an oxygenated liquid drawn into the lungs. Adult mice induced to breathe fluidically have successfully returned from pressures equivalent to depths of over a mile. Among the major limitations are the much greater exertion of inhaling and exhaling a liquid rather than a gas and the buildup of carbon dioxide in the breathing fluid. Limited experimentation with humans is believed to have taken place.

Saturation Diving

One physiological obstacle to increased depth that can now be circumvented is the immobilizing, time-consuming need for underwater decompression. Gradual decompression after an extended or deep dive is mandatory, for under pressure the concentrations of inert gases dissolved in the blood increase and it takes time to release them safely through the lungs. Excessively fast decompression, like opening a bottle of pop, will cause dissolved gases to bubble out in the blood stream bringing on the "bends", a perilously incapacitating or lethal condition. There also is a limit to how long a decompressing diver can hold on to a line in cold water and hence to how deep he can go and how much time he can spend doing useful work.

The requirement to decompress in the sea has been eliminated by the deck decompression chamber (D.D.C.) and the personnel transfer chamber (P.T.C.). A group of divers can live in the D.D.C. aboard a tender for an extended period while performing their tasks and later while undergoing a controlled reduction of pressure. The smaller P.T.C. shuttles divers between the underwater work site and the D.D.C. and can function as a backup decompression chamber. These integrated decompression systems, which the oil industry and the Navy have brought to operational status, bring a fair measure of weather-independence to undersea work by greatly reducing the time necessary to terminate diving operations. Divers can be decompressed on the way to port rather than tying up a whole operation until decompression is completed.

The well-equipped D.D.C. leads to the advanced capability of staying at greater pressure (therefore depth) for a day or more. This is sometimes called saturation diving since the dissolved gases in the blood have sufficient time (it takes about 24 hours) to come to equilibrium relative to the ambient pressure. During the traditional dive, lasting a few hours at most, the blood's dissolved inert gas content steadily increases and the time required for subsequent decompression thus increases not only with depth but also with time spent there. But once a diver is saturated the decompression period becomes independent of the time under pressure. Saturation diving has dramatically increased the bottom time available—an advantage that becomes greater with increased depth—since daily decompression is eliminated from the work procedure. At 250 ft. a diver operating from the surface and decompressing after each dive may perform an hour or two of work per day; a saturated diver potentially can work a full eight-hour shift or more (there are other problems, however, that will be discussed below).

Thus the duration of the deeper dives has quickly jumped from minutes to weeks and months while the depth attainable has also increased.

Basic Gas Mixtures

Gas mixture	*Practical depth limit*	*Depth limited by:*	*Disadvantages*
Pure oxygen	30 ft.	Oxygen toxicity	Dangerous and somewhat unpredictable
Compressed air or Nitrogen-oxygen	250 ft.	Nitrogen narcosis	Depth limited
Helium-oxygen	1,000 ft.	Danger of convulsive seizures (high pressure nervous syndrome), but may soon be extended to approximately 1,500 ft.	Diffusion properties of helium; Thermal properties of helium; Speech problems due to helium
Hydrogen-oxygen	3,500 ft. (?)	Hydrogen narcosis (?) and pulmonary circulation constraints but may be limited to much shallower depths by central nervous system limitations	Relatively unexplored gas mixture; Diffusion properties of hydrogen; Thermal properties of hydrogen; Speech problems due to hydrogen; At depths of less than 200 ft. oxygen is at greater than 3 per cent, providing an explosive mixture

The interaction of high-pressure gas mixtures (including air) and other sources of stress makes difficult the prediction of diver performance, which undergoes degradation as soon as the diver enters the water. Abstract thought and organization suffer most, routine tasks generally least.

Much of this technology is regularly used in offshore oil work. Limits on diving time are now imposed by support facilities, equipment reliability, and psychological factors. Divers have gone below 1000 ft. in open waters, and though still experimental and risky it is now possible for men to work for several days at such depths. Human saturation "dives" below 1,700 ft. have been made in hyperbaric chambers; and in similar experiments various mammals have returned in good health from pressure equivalents of 3,000 ft.

An additional advantage of the saturation technique is that the diver is physiologically able to make appreciable excursions downward from his saturation depth without requiring decompression to return. The deeper the saturation depth the farther the diver can go in time and distance. The downward-excursion capability is due to the increase in the saturation pressure and the linearity of the pressure increase with depth. If a person saturated to 1 atmosphere of pressure (sea level) descends 100 ft. the pressure increases 400 per cent to 4 atmospheres. On the other hand, a diver who is saturated at 300 ft. (about 10 atmospheres) and who descends an additional 100 ft. to 13 atmospheres experiences a smaller relative pressure change of 30 per cent and consequently a smaller relative increase in gases dissolved in his blood. Upward excursions, however, remain limited and very dangerous, for at any depth above saturation the blood becomes supersaturated and the dissolved gases can easily form bubbles.

Habitats: For Science Only

Most commercial firms using the saturation technique house their divers under pressure in a D.D.C. and ferry them to and from the work site by P.T.C. The divers may be saturated to depths above the working depth, or to full depth. This approach still requires extensive operations across the air-sea interface and is critically dependent on surface support. It is not easy to maneuver or to transfer large, clumsy equipment from a surface vessel that may be rotating and drifting in several directions under the influence of wind, waves, and currents. These motions and therefore the possibilities of mechanical failures impose significant risks on the success of the projects and on the safety of personnel. Vulnerability to surface weather and sea states can be alleviated somewhat by good communications and by the use of independent or redundant subsystems such as self-contained breathing equipment and power supplies and small mobile diver havens. But compared with the alternative of providing an independent underwater habitat adequate for extended undersea living this pressurized commuting is still the more flexible, mobile, cheaper, and safer approach. Except for specialized movable shelters for the underwater welding of pipelines and the occasional use of the small havens, habitats have not yet been proven practical as part of undersea work systems.

State-of-the-art habitats still require the use of D.D.C.s, P.T.C.s, and surface vessels for support services and emergencies. To date, they have generally depended on electric power and communications, and in some cases piped supplies of premixed breathing gas and fresh water from land or sea surface. The commercial applications of saturation diving have so far not required the extended diving time in fixed locations that could help justify the use of large habitats. Submersibles with diver lock-out capabilities, built-in decompression chambers, and the capability of deploying themselves directly from ports without assistance may well be the long term answer. They would combine the advantage of independence from surface support with those of flexibility and mobility. Unfortunately they are very expensive and there isn't enough current demand to keep even one such large vessel busy enough to justify its design

At, depth, cold is one of the chief factors in performance degradation. Much development is directed at heating diver suits with electricity or circulating warm water.

and construction.

All the same, there has been and still is considerable interest in undersea habitats. The increase in habitat capabilities was particularly rapid prior to the death of a diver in early 1969 and the subsequent cancellation of the ambitious Sealab III project (see illustration on p. 32). Since this time the interest in habitats has switched from development of the technology and demonstration of maximum capabilities to the exploitation of proven technology at relatively shallow depths. The motivations have also changed from military and commercial applications to scientific uses. The shallower depths have the advantage of reductions in costs, complexity, and risks, and they permit non-professional divers to participate. The successes of the Tektite I, Tektite II, and FLARE projects among others have demonstrated the value of habitats for biological and physical research. These types of programs can be expected to continue and many are currently in planning; and perhaps within 10 years they will develop habitat systems capable of supporting life and work on the continental shelf relatively independent of surface support.

Diving Physiology

The central task in diving technology is to provide the diver with a breathing mixture adequate to support life. This difficult problem is compounded by the fact that the gas mixtures have interacting effects with other sources of diver stress. The basic diving gas mixtures (see illustration on p. 33) are pure oxygen, compressed air, nitrogen/oxygen, helium/oxygen, and hydrogen/oxygen. Helium/air or helium/nitrogen/oxygen combinations are also used (see illustration on p. 33), and more complex mixtures are being considered. Neon, argon, krypton, and xenon, as well as methane, carbon tetrafluoride, and sulfur hexaflurode have been mentioned as possibly useful gas mixture components although some of them obviously have problems. Since variations between individuals can be significant, the depth limitations specified in the table are not absolute, and greater depths can often be achieved at higher risk.

As mentioned earlier, one of the important obstacles to very deep diving is the difficulty of monitoring and controlling the oxygen supply. Human tolerance to quantitative variations in oxygen decreases with increasing depth. In long duration dives the oxygen partial pressure must stay in the 3-8 lbs./sq.in. region regardless of the total pressure. In a dive at a depth of 1000 ft., for example, where the pressure is about 500 lbs./sq.in., oxygen partial pressure must stay at about 1 per cent of the total, as against 21 per cent at sea level. Moreover, contaminants such as carbon dioxide and carbon monoxide are much more lethal at greater depth and must also be very carefully controlled.

The accepted depth limitation for air or nitrogen/oxygen mixtures is about 250 ft. due to the onset of nitrogen narcosis. Although this effect is not normally a serious problem at less than 200 ft., tests in dry pressure chambers show that it causes significant degradation of performance at the equivalent of 100 ft. Performance levels drop still lower in similar tests at the same depths in water. Some researchers have also found surprising performance decrements with helium/oxygen mixtures at 200 ft., a small fraction of the generally accepted depth capability of these combinations.

In addition to significant differences between man's performance in dry pressure chambers and in water there are performance losses at sea level pressure just from being immersed in sea water. These effects arise whatever the gas mixture and are related to other stresses of diving—including cold, anxiety, weightlessness, reduced vision, exertion, and poor or non-existent communications. When combined, such stresses frequently interact in complex ways. Since stress levels are extremely hard to measure and evaluate in man, due in part to individual differences, it is often hard to separate out the effects of a particular stress. Personal characteristics of individuals who will perform well under these types of stresses are handled probabilistically, giving some basis on which to make personnel selections for diving projects.

Under stress, performance on different kinds of tasks do not degrade to the same extent. Routine functions seem least affected and those requiring abstract thought and organization the most. This makes sense if we assume that human behavorial patterns are organized according to a hierachical scheme in which the higher levels are characterized by greater complexity. While such degradation may not always occur—under test conditions highly motivated divers may concentrate on a particular complex task and do it well—success is generally achieved at the expense of overall awareness. Testing suggests that less reliance should be placed on the diver's initiative and that more effort should be devoted to pre-planning and pre-engineering.

Divers are limited in working time

chiefly by the cold of the deeper waters—often 40°F. on the continental shelf. Continuous heat loss leads to fatigue and a cumulative "thermal debt" that can be dangerous. The major penalty extracted by the body heat loss is rapid deterioration of work performance. Since divers often rely on the sense of touch under conditions of poor visibility, they are often faced with a trade-off between wearing thick gloves, virtually eliminating the effectiveness of their tactile sense, and not wearing gloves, thereby losing the same sense to numbness.

The Common Cold, at Depth

The insulating properties of neoprene wet suits may decrease as much as 80 per cent due to compression of the material with depth, while dry suits can lose their insulating advantages to occasional minor water leaks from defective seams, poor fit at seals, and rips. In any case the effectiveness of these protective materials is reduced by use of breathing mixtures containing inert gases with high specific heat capacities. Thus at 600 ft. a dense helium breathing mixture may remove more than 100 per cent of a diver's metabolic heat in the expired gas alone as compared with 10 per cent by air at one atmosphere. With today's helium/oxygen, deep-diving systems the maximum effective working period in cold water is still only about two hours, even with preheated gas mixtures and dry, heated, multi-layered clothing, whereas in warm water over 10 hours of work time per day has been recorded.

Considerable development effort has gone into heating diving suits and preheating breathing gases. Electrically heated suits drawing up to 1000W. and circulating-warm-water outfits (derived from astronaut space suits) are in use. Most of these efforts require a line connecting the diver to the electricity or heated water. The major problem is not in providing enough heat but in controlling its distribution, especially to the hands and feet. Although progress is being made, the objective of keeping warm at depth has not been achieved.

The increased thermal conduction and convection of high-pressure gas also can be important in the dry environment of a habitat. Helium at 11.2 atmospheres (about 350 ft.) has a natural convective heat transfer coefficient 7 times that of air at sea level. With the forced convection that may be necessary to thoroughly mix and distribute the relatively small quantity of oxygen in the dense atmosphere of a habitat, this factor may be raised to over 12. Under such conditions the human comfort zone narrows considerably and the habitat's air temperature has to be maintained closer to skin temperature. At depth the warmth must approach skin temperature (about 90°F) to provide the same degree of comfort as does 72°F at sea level.

Although divers suffer significant degradation of their capabilities compared to what they can do on land it is established that they can do useful work even at the greatest attainable depths. In the long run their performance should improve due both to the accumulation of knowledge of the psychological and physiological factors involved and to engineering improvements in life-support systems. The developments will continue to be stimulated by commercial pressures, such as the oil industry's need for better, deeper, and cheaper undersea capabilities, and by scientific and national-security considerations. A considerable increase in the work capability of swimming divers will also be achieved by the introduction of adequate force and torque-compensated tools and smaller, more reliable communications and navigational devices.

Suggested Readings

Principles and Observations on the Physiology of the SCUBA Diver by Gaspare Albano, 1970, a comprehensive study translated from the Italian, is published as ONR Report DR-150, GPO Number S/N 0851-0040. A wide-ranging and practical collection of papers on diving is *The Working Diver,* Proceedings of the Marine Technology Society Symposium of Feb. 22-23, 1972. *Scientist-in-the-Sea: Tektite 2,* a 612-page report on a habitat experiment, may be obtained from the U.S. Department of the Interior. A comprehensive article entitled "Submersibles and Underwater Habitats: A Review," is carried in the August 1972 issue of *Underwater Journal,* pp. 149-167.

Alan L. Frohman
Pugh-Roberts Associates, Inc.

Fighting Fires: Only the Truck Is New

Next time you happen upon the scene of a fire, fight the impulse to watch the flames. Instead, watch the fire department. What you will see is 19th-century technology and techniques fighting an age-old menace. Water remains the principal extinguishing agent; the fire department's job is to deliver the pumps, hoses, nozzles, and men needed to get the water onto the fire. Delivery by a truck powered by an internal combustion engine has replaced delivery by horse-drawn wagon: that is the only obvious change.

Hoses still have to be lifted, carried, and pulled into place by hand. Forty-pound hose lengths are still bound by multiple-turn brass couplings. Once hoses are in place, one man still has to stand by each pumper and manually control the water pressure in several lines, making calculations and adjustments to compensate for changing conditions. Much of the communication on the fireground is still by hand signal and shouting.

The firemen themselves dress in bulky, ill-fitting clothes that do not protect them well. Most firemen's coats are flammable, and plastic helmets sometimes melt on their heads.

Alan L. Frohman serves Pugh-Roberts Associates, Inc. as a senior consultant, specializing in organizational development and human resources management. Before joining the firm, he performed studies in those areas for several large corporations. A graduate of the University of Rochester in psychology, he received his master's and his doctorate from the Sloan School of Management. Mr. Frohman wishes to express his great appreciation to Mr. Harvey P. Utech, of the National Bureau of Standards, for his assistance in the research for this article.

The breathing apparatus designed to protect firemen from smoke and toxic fumes if they enter a burning building is heavy (it weighs 35 pounds), bulky, and of limited use (it provides only 15-20 minutes of air supply). Firemen frequently try to make do without it, and, predictably, smoke inhalation remains the firefighter's most frequent disabling injury. That firemen are successful at all in controlling fire is a tribute to the bravery, resourcefulness, and determination that have become a tradition in the service.

The fire department is not the only public service area whose technology is archaic and outmoded. Police, traffic control, and sanitation departments also use the same types of tools now as they did a half-century ago. Yet, this lack of progress cannot in most cases be attributed to an absence of newer technology. Many examples of new technology which could be used to fight fires can be cited. Light, quarter-turn hose couplings, new types of forcible entry tools, lighter, less bulky breathing apparatus, new types of extinguishing agents and improved protective clothing such as helmets and firefighting coats can be made. But there are economic, political, and psychological barriers to their introduction into fire fighting.

The irony of the situation is that most efforts and programs are aimed at solving the technological problems, not the economic, political, and psychological ones.

An Innovation That Tried: Jet-Axe

Perhaps we should begin with an example of a useful product that was introduced during the past few years: an explosive entry tool. It was not widely used, and thus well illustrates our case.

Firemen must often forcibly enter a building to attack and ventilate a fire. Conventional tools such as axes and power saws, although frequently sufficient, are sometimes too slow, too unsafe, or simply do not have the necessary force.

Explosives Technology (E.T.) is an eleven-year-old California-based firm with 1971 sales of $4.1 million and a payroll of 130. One of its major products is linear explosive cord, for which the firm has developed a proprietary manufacturing process.

In 1967, the firm began to look for new markets. Several big-city fire chiefs persuaded it to develop an explosive entry tool. The early prototypes were refined on the basis of varying comments from several departments. Nevertheless, E.T. was able to screen the many inputs it received and distill them into an attainable set of requirements.

E.T. put prototypes of Jet-Axe into the hands of several West Coast departments in 1969. It developed a detailed set of training documents and a training film. Distributors were solicited and found eager to carry Jet-Axe; many, in fact, contacted E.T.

But, the sales of Jet-Axe have been very disappointing and far below E.T.'s market estimate: most have been to the West Coast departments that advised E.T. on the tool's development.

Why? The answer is anything but obvious. Those who have used Jet-Axe are generally satisfied. Several enthusiastic articles on Jet-Axe and stories of its use in actual fire situations have appeared in the fire services literature. Most fire chiefs seem to agree that the tool is needed. It costs less than $100 per unit, and most chiefs state that the cost does not deter them. However, the cost

Much of America's firefighting technology is obsolete. We labor to improve equipment and communications, but we pay scant attention to resolving the real constraints—which are economic, political, and psychological.

Equipment that is hard to organize and inefficient hinders the fight against a fire: heavy hoses such as these are connected by multiple-turn couplings, and their connections to the pumper require that a fireman stay at the truck to control manually the water pressure through the several hoses. But couplings that take only a quarter-turn to fasten are available, although they are not yet widely used. The truck in the background does demonstrate one new feature: the telescoping boom or "cherry picker", which is replacing the old-fashioned ladder. (Photo: Gary V. Deep)

The personal equipment issued to fire fighters offers poor protection during dangerous fires: their coats are bulky and heavy, their plastic helmets can melt. But there is a new material for making coats—Nomex, a high-temperature-resistant nylon—that is lighter, more durable, and more flame-resistant. Nomex coats are up to twice as expensive as the older ones; however, they are being bought and used.

does appear to discourage use of the device in training and perhaps the men lack enough experience with it to use the tool readily in actual situations. Two chiefs who had purchased Jet-Axe indicated that their men did not use it as much as they might because they either preferred the more conventional tools or were not familiar enough with Jet-Axe to think of using it when the occasion arose. Thus, even when a department purchases Jet-Axe, it is not being used when it could be.

The Market for Fire Equipment

To understand why something like Jet-Axe sells so poorly, we must understand the nature of both the manufacturers of firefighting equipment and their customers. Some 100 manufacturers use some 400 distributors to sell roughly what is listed in the box in the next column.

There are 25,000 fire departments across the country. The 4,000 who pay some or all of their firemen employ around 250,000 men; they are found mainly in urban areas. Another 1,250,000 firemen serve 21,000 volunteer departments mainly in rural areas. Some departments have only a few men. The giant New York City Fire Department employs over 14,000. Many small volunteer departments respond to fewer than 100 calls per year, and some active city companies handle 100 calls per week.

A number of characteristics of firefighting and fire departments show why innovation is difficult:

☐ As we have seen for Jet-Axe, firefighters generally have not been taught enough about their equipment technically. Fire departments without technical specialists have trouble evaluating innovations produced by industry and specifying what they need. A few fire departments have hired equipment specialists, however. One city has three to help write specifications and purchase equipment. Another, a small city, has hired college graduates at the rank of captain. (Very few firemen have college credentials or acquire them during their careers.) Both cities are regarded as technological leaders in public service equipment.

☐ Because fire departments are largely in-grown organizations, word spreads slowly of how well an innovation works. Over the years, different departments develop many differences in their tactics and methods. Virtually every big city chief has achieved that post by moving up through the ranks in that city. There is almost no transfer of personnel from one city to another: hiring an officer from another department because he has a special expertise or skill is rarely done. Furthermore, innovative products tend to become identified with the cities that first use them—the Jet-Axe with Seattle, for example. This has two bad effects. First, the innovative department is reluctant to say anything bad about its baby. Other departments recognize this, and are skeptical about favorable reports. Second, a combination of civic pride and a "not-invented-here" syndrome seems to grip many departments and they shy away from products identified with others. Both stifle the kind of "bandwagon" effect that helps innovations to be accepted in other fields.

☐ There is no objective way to measure the effectiveness of a fire department. Yet one of the major factors governing the rate of diffusion of an innovation in industry is the economic advantage produced by the innovation. In the private sector this is easily gauged by a firm's sales and earnings, but criteria have yet to be developed for public agencies. Since we lack the means to measure a fire department's overall effectiveness, we have no way to evaluate the contribution made by an improved piece of firefighting equipment.

☐ A classic problem in all bureaucracies, which is apparent in fire de-

Pumpers	$ 72 million
Ladder trucks	16
Other vehicles (squad cars, rescue vehicles, etc.)	15
Protective clothing and equipment	33
Hose	19
Other items (radios, chemicals, etc.)	20
Total	$175 million

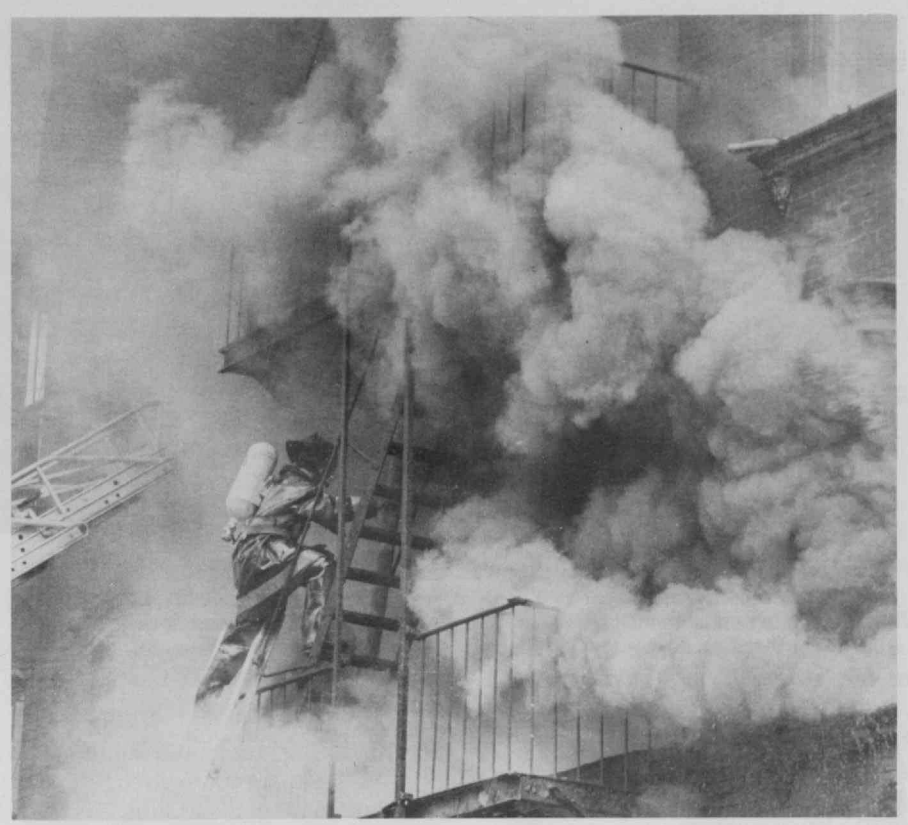
partments, is the lack of incentive to improve. The purchase of any new piece of equipment entails risk. In many fire departments, the individual advocating a change in equipment sees that he will lose more if the equipment fails to meet expectations than he will gain if it succeeds.

☐ Improved products are often more expensive than their predecessors. When most fire departments' budgets are shrinking, fire departments are not looking for new ways to spend money. On the other hand, the initial cost of equipment seems to get too much attention in fire department thinking. Comparative cost of maintenance and cost per year of use get too little, and the premium-priced but more durable product is slighted.

☐ The National Fire Protection Association (N.F.P.A.) and the American National Standards Institute (A.N.S.I.) currently set forth minimum standards. These tend to be descriptive standards, specifying the composition of the equipment, rather than performance specifications, indicating what the equipment must be able to do. They may even name the process by which the equipment parts should be manufactured. Such standards leave little opportunity for innovation.

Furthermore, the N.F.P.A. specifications have been granted quasi-legal status by the courts. A firefighter who is injured may begin a law suit if he believes his injury was caused by faulty equipment. He may direct it either at a manufacturer, if he claims an improper design, or at the city, if he claims maintenance was faulty. The court will normally consider whether the equipment meets N.F.P.A. specifications: if it does not, the court is more likely to find for the claimant. Whether or not an item of equipment meets N.F.P.A. specifications, therefore, is important in purchasing and can outweigh the promise of greater effectiveness.

☐ Firefighters in a given department work together at a fire as a team. Their cohesiveness is built and maintained by sharing experiences and dangers and by fighting fires in well-established ways. Introducing a new product can necessitate changes in the team's operations that can disrupt the unit and threaten its morale. This also can outweigh an innovation's promise.



The breathing apparatus a fireman carries is heavy, bulky, and limited in its oxygen supply—and the most common occupational injury is smoke inhalation. The aerospace industry and the military have developed some equipment that is applicable: lighter tanks, lighter oxygen regulators, and better face pieces have been put together to make a unit that weighs about 14 lb. for a 45-min. air supply. The conventional units weigh 30 lb. for 30 min. of air. The new device is about half again as expensive as the present one, about $450. (Photo: New York News)

☐ Each fire department has its own procedures for purchasing and its own desires and demands. This means there are over 25,000 individual and physically dispersed customers who may want the same product but in different variations. One fire department may want a fire truck with 1,000-gallon water tanks and a particular engine with two starters. Another fire department may want the same type of fire truck but with 1,500-gallon tanks, a different engine, and one starter.

Each department tends to think its needs are unique. Hence, the appeal of any piece of new equipment will differ markedly among departments. This fragmentation of needs results in a limited market. A manufacturer cannot be sure of the demand for new products, and the economical features of mass production and product-line standardization cannot be achieved.

Two characteristics of manufacturers also make innovation harder:

☐ Fire equipment manufacturers appear on the average to be old, well-established firms heavily concentrated in the Middle Atlantic and Midwestern states. Most are small: two-thirds have fewer than 100 employees. The smaller firms tend to remain small, apparently because profits are too thin to generate growth. They lack the resources to sponsor much new product development.

Larger firms that have the resources to develop new products for the fire services appear to find other markets more attractive. Most products used by the fire services were initially developed for other markets. For example, three manufacturers sell to firefighters breathing equipment originally designed for miners, aviators, and scuba divers.

☐ Manufacturers in general are not familiar with the needs and operations of firefighters, for several reasons. The distributor serves as a buffer between manufacturer and customer. While the distributor re-

One more new device that would permit firefighters to get hoses closer to a fire than a human can is a small maneuverable robot that has a remote-controlled nozzle. It costs about $10,000, and has not yet been widely accepted, perhaps because its use is rather special and it affects tactics on the ground considerably. (Photo: L. Richard Young for the Marion, Indiana, *Chronicle-Tribune*.)

duces the number of contacts a manufacturer needs to sell nationally, he tends to insulate the manufacturer from reports about his product from customers.

Overcoming the Barriers to Innovation

These barriers are not deliberately built to suppress innovation. They are characteristics of a system of manufacturers, distributors, and consumers which once protected the interests of each of those parties. But new technology by itself will not cause much improvement in the fire services. Progress will come only after a comprehensive program attacks the barriers that suppress innovation. Here is such a program.

Three steps are vital. They are the education of firefighters, the consolidation of the fire services market, and the improvement of mechanisms for the introduction of new technology. All are essential. One or two alone will have scant impact, as all the barriers will not be dealt with.

We believe the country should establish a national training academy (or several regional academies) for fire officers. The academy would stimulate more open-minded, creative thinking among fire service personnel; help to establish a body of common knowledge about fires and firefighting and a set of common interests and requirements that should simplify the market; and encourage the transfer between departments of knowledge and information about all aspects of firefighting, including tools and equipment. It would also prepare firefighters to take on management jobs. Its staff would serve as a resource for all fire departments.

In addition to the national academy, training courses administered locally or regionally should be developed.

The market should be consolidated, and we believe that improving existing standards and specifications would help to do that. The people responsible for purchasing equipment rely mainly upon their own judgment; there are no other rigorous, comprehensive sources of information. If fire departments could use national standards to assess their equipment and to order new equipment, the market would become less fragmented and customized.

New standards must emphasize product performance rather than description, and must acknowledge the performance demands that firefighting imposes. Our present standards will need aggressive revisions which are best done by increasing the representation of fire departments on the voluntary standards committees. Those committees must find fire service representatives who have strong technical backgrounds. The committees should produce a system of graded standards with several levels of performance. They should set upper levels beyond the performance of anything on the market, to provide a continuing incentive for manufacturers to improve their product's performance and to make keeping the standards up-to-date easier. As improvements occur, lower performance levels can be dropped and upper performance levels can be revised.

However, even the best of standards will continue to have limitations. They can only specify minimum levels of performance, and some fire departments may want performance that is substantially better. There are some performance characteristics that are customarily left out of minimum standards, such as durability and appearance. Fire department requirements will differ in certain particulars for perfectly good reasons; for example, the engine requirements for a 17-ton pumper in Los Angeles that can handle 33 per cent grades will be different from those for one in Phoenix, where the terrain is flat. We suggest, therefore, that the standards committees might draw up forms based on performance tests, with blanks for each chief to fill in the levels of performance he wants. If the committee's specifications are backed up by data from careful performance testing, fire chiefs will find it easy to specify exactly what they want. If a department states its needs in performance requirements rather than in brand names and model numbers, it asks for competition among suppliers.

The flow of information between the manufacturer and the user must be improved. Most companies with goods applicable to the fire services are usually unfamiliar with the

problems and needs of the fire services, uninformed about how to sell to them, or unaware of how to find out about these things. Useful new products from firms outside the fire services market do not get introduced to the fire services. When a new firm does enter the market, it thrashes about looking for information and guidance and all too often ultimately relinquishes its effort.

Both parties need a matchmaker to help good new ideas become market breakthroughs, and that is our third proposal. The matchmaker would fit new technology to the needs of the fire services, give technical assistance to firms hoping to sell to them and help the developer and the user to work together. This organization must have both its own technological expertise and a familiarity with the needs and operations of fire departments and their suppliers. It might provide services such as coordinating field testing and development funding, advising manufacturers on marketing, and looking for new devices in other industries that could be useful in fighting fires.

Implementing the Solutions

The program we have outlined is modest. It is not revolutionary or expensive. It preserves the present fire equipment marketing system. And much of it can be accomplished by existing institutions.

For example, the National Fire Protection Association and American National Standards Institute might improve their equipment standards. Manufacturers might report the performance of their products, using generally accepted test methods, in their advertising. Fire departments might explore new ways to increase the technical expertise available to them.

The National Bureau of Standards, under authority of the Fire Research and Safety Act of 1968, has, for the past two years, modestly funded an effort to improve firefighting equipment. The Bureau is developing model purchase specifications, testing equipment, sponsoring limited development efforts, and serving as a matchmaker between fire departments and industry. The National Aeronautics and Space Administration is applying various bits of aerospace technology to firemen's clothing and personal equipment as well as to their communications equipment.

Thus, most of the recommendations in the preceding section can be or are being implemented through existing institutions, and the establishment of a federally funded National Fire Academy is currently being studied by the National Commission on Fire Prevention and Control.

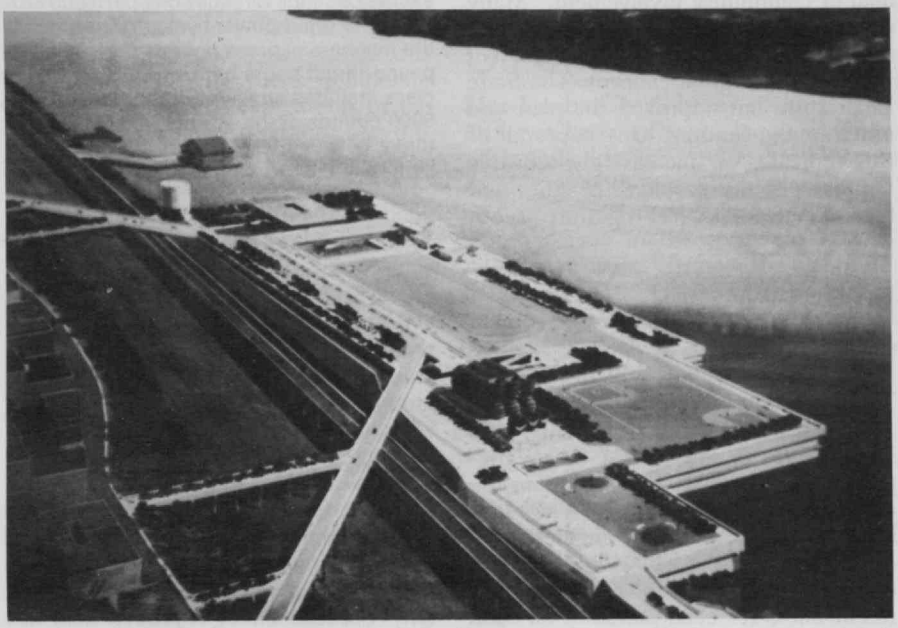
Making more funds available to fire departments would probably do little by itself to stimulate innovation in fire service equipment, but we hope that funds will be available, as standards and specifications are improved, so that the combination will encourage investment in new product development. Since experience shows us that new product development is best carried out in the private sector, we recommend federally supported development only as a last resort.

The fire services are not alone in their need for a faster pace of innovation. The President has recognized that we must promote the continued and increased development and application of U.S. technology in order to meet social problems and to promote economic growth. Fire suppression and prevention are one social problem area among the many; the barriers to innovation in the one exist in varying degrees and shades in the others as well.

Certainly there are technological solutions to many of our public service problems. Our desire is not to end the search for new technologies. Rather, it is to see coupled with this search a recognition of the economic, political, and psychological barriers. Otherwise the technological solutions will not be used.

Trend of Affairs

Trends This Month



This first rendering of Manhattan's Riverbank Park gives no visual clue that its 30 green acres cover the reinforced roof of an enormous water pollution control plant supported by 2,500 piles sunk in the bed of the Hudson River. The park will open about 1976-77 and be completed in the early 1980s.

ENVIRONMENT

An Elevated Park For New York

New York has always been a rooftop kind of city. Kids find their open spaces on the tar and gravel tops of row houses, apartment buildings, and garages. For adults the roof is a place to socialize, sun bathe, and breathe "fresh" air. Sometimes apartment owners, often as a gesture, scatter folding chairs and potted junipers and geraniums amongst the elevator housings and bathroom vent pipes.

Now comes the grandest New York rooftop of them all: the State Park and Recreation Commission, with federal support under the Legacy of Parks program, will build a 30-acre rooftop park. About 10,000 persons a day are expected to make use of its picnic area, playfield, three multi-purpose courts, bubble-top swimming pool, wading pool, and open-air ice-skating rink.

But where in Manhattan, the vertical city, can 30 acres over one roof be found? Not on dry land. The park will be on top of the North River Water Pollution Control Plant, which is being built on piles over the Hudson River just off a section of Harlem between 135th and 145th Streets. The $750 million advanced secondary sewage treatment plant, under construction since February, 1972, is being partly funded by the Environmental Protection Agency.

Estimated to cost about $80 million, $48 million of which is for foundation work and other preparations, the park will be built in stages and should be completed in about 10 years. It will be opened in stages, too, starting in 1977 or 1978.

The roof of the plant is designed to

support a 400-lb. load per sq. ft., which means it can bear only 4 ft. of a special light-weight dirt and 3½ ft. of water. The park's landscape architect believes that the dirt—which will be trucked in across two permanent bridges—is enough to sustain and hold securely London plane trees, pin oaks, willow oaks, and willows.

The idea for the park started when New Yorkers began thinking about the dismal prospect of a featureless 30-acre roof jutting over their river. At the Mayor's request the State Commission did a feasibility study in which Lawrence Burr, Assistant General Manager of the Commission's New York City Regional Office, feels there was a great deal of community involvement. "Many of the ideas are a direct result of citizen inputs," he said, and not the least of them is the original concept. The State Legislature has approved the plan and much of the funding. One hopes all of this indicates an increasingly sensitive approach to the problems of cities and their inmates—not just a gesture.—*R.S.*

	1976			1979		
Engine type	*CO*	*HC*	*NO_x*	*CO*	*HC*	*NO_x*
Turbine—T1	11.3	8.7	—	2.2	1.0	3.7
Turbine—T2	11.9	2.5	—	2.1	0.4	3.2
Turbine—T3	11.3	2.5	—	1.7	0.4	3.0
Turbine—T4	11.9	2.5	—	2.1	0.4	3.2
Piston	—	—	—	42.0	1.9	1.5

This is a list of some of the E.P.A.'s proposed regulations on airport emissions. For piston engines the numbers express pounds of emissions per 1000 times the rated power cycle; for turbines, the numbers express pounds per 1000 pound-thrust hours per cycle. The T1 class includes engines with less than 6000 pounds of thrust; the T2, those of thrust between 6000 and 29,000 pounds, generally the turbojet engines like the JT3D; the T3 class, those of greater than 29,000 pounds of thrust, generally the high bypass ratio fan engines like the JT9D; and the T4 class, medium-thrust engines like the T2 class, but of a low bypass ratio fan type like the JT8D. Besides these rules on specific emissions, the E.P.A. also proposes stringent limits on the amount of visible smoke that each type of craft can emit.

E.P.A.'s Proposal for Airport Emissions

The Environmental Protection Agency (E.P.A.) held hearings in Boston and Los Angeles in late winter on its proposed 1976 and 1979 regulations on aircraft emissions at airports. The regulations divide aircraft engines into classes according to how much thrust they produce at takeoff, and place different limits for each pollutant on each class. Thus, a new class T4 engine, such as the JT8D that powers the 707, would have to put out no more than 2.1 lb. of carbon monoxide per 1000 lb.-thrust hours per test cycle. The table at the right details the limits. The engines would also have to meet requirements on the smoke in their exhaust.

The air carriers naturally gave their views at both hearings; these more general statements were followed by a memorandum to the E.P.A. from Clifton F. von Kann, Senior Vice President for Operations and Airports of the Air Transport Association, which contained more technical information. While some of the comments in these statements about the airlines' activities in the reduction of emissions and smoke were self-serving, a number of their objections to the proposed regulation were sound.

For example, Mr. von Kann explained their reservations about how emissions from any engine are quantified and how the levels of pollutants around an airport are determined. The Clean Air Act of 1970 gave the E.P.A. only 270 days to establish a baseline of aircraft emissions from which rules could be made. Eight different teams tested over 400 engines, both new and used, with probes produced by Southwest Research Institute (S.R.I.). Neither the method of testing nor the probes had been proven to give accurate, repeatable data. Mr. von Kann quoted an interim report from S.R.I. to the E.P.A.: "The basic design, allegedly derived from a similar Pratt and Whitney probe, was a lightly-qualified disaster. It was not a complete disaster only because enough probes held together long enough so that some data could be collected. . . ."

The probes are held at different places in and near the engine as it runs, but a great difficulty—even if the probes worked—is where to place them, for readings only a few inches apart, vary by orders of magnitude. The measurements by three teams on JT8D engines which had been equipped with a new smokeless burner and on JT8D engines which had not gave varying results, Mr. Von Kann reported: NO_x emissions per cycle increased by 0.062, 1.326, or 1.605 lb.; CO emissions went down from 2.323 to 7.936 lb.; and hydrocarbons went up 0.168 lb. or down by 2.660 lb.

Mr. Von Kann also questioned the way in which the E.P.A. set its standards for overall airport air quality. The projections and standards for Los Angeles International Airport are based, he said, on readings taken for six months including the summer in 1970 which were extrapolated across all 12 months and then projected for the coming several years. That, he says, is meteorologically unsound. Furthermore, the readings at one station near the east end of the north runways did not change whether the winds were easterly or westerly. He described an experience Heathrow Airport had in trying to measure its own air quality. Researchers established two stations on either side of the airport so that the prevailing westerlies would sweep over point A as they began to cross the airport and over point B as they left it. The air measured at point A, they found, had more pollutants in it than the air at point B. Heathrow is upwind of London.

Greater Discretion for the Airlines?

During its whole visit at an airport, an aircraft emits most of its pollutants while taxiing, so the E.P.A. also proposes to govern that operation; aircraft would have to taxi on only one or two engines, depending on type, and could not start up even those until given clearance by the control tower to prepare for take-off. The carriers would rather simply emphasize that unneeded engines should be shut off, and leave the actual control to the individual airlines and pilots. Part of their plea was for safety, they said. Some mechanical problems with an engine become apparent only after it has fully warmed up, and that might not happen under the E.P.A.'s scheme until it was airborne. And planes, airports, and weather conditions all vary, so they feel one rule is simply inappropriate.

Finally, the airlines believe that the standards are mechanically unfulfillable: in one instance, at least, this might be so. Several years ago, the carriers began to retrofit the JT8D-type engine (a low-bypass ratio turbofan

that lifts the 727, 737, DC-8, and others—presently some 80 per cent of the nation's fleet) with a new smokeless burner which enables it to meet even the 1979 requirements. They also instigated research to find a new combustor for the JT3D-type engine (a turbojet which lifts the 707, DC-6, and others). This is largely a trial and error business, and the engine seems intractable—in this case the manufacturers and carriers are trying.

The S.S.T. Would Never Pass

The proposed regulations, if they are made law, will have one effect the E.P.A. did not plan: according to G. P. Sallee, a development engineer for American Airlines, they will restrict what kinds of engines can and will be built and thereby what kinds of airplanes will be built.

The regulations describe a 32.7-minute test cycle which includes 19 minutes of taxiing and idling during takeoff, 7 more during landing, 0.7 minutes of actual takeoff, 2.2 minutes of climb, and 4 minutes of approach. But this cycle is inappropriate for two types of aircraft that are now under development, short and vertical takeoff and landing types (*S.T.O.L. and V.T.O.L.: See* Technology Review *for May and June, 1972*), and if the rules are applied to these craft, they will inhibit their development.

Those planes would never taxi and idle upon takeoff for anything like 19 minutes, Mr. Sallee told the *Review*—perhaps for four. Using the long cycle, however, one S.T.O.L. craft that is available commercially, the De Havilland Twin Otter, would be granted a certificate, for its design includes an engine whose bypass ratio is well over 100:1.

Several of the types of planes that might be built for V.T.O.L. flight would simply not meet the emissions rule, he continued. An augmentor wing design would be out; an externally blown flap wing might not be, for it could be used with a lift engine that had a bypass ratio of 20:1.

The proposed regulations do declare, however, that they do not apply to the helicopter, the one V.T.O.L. plane now in a commercial use. Mr. Sallee knows of no plan to have either V.T.O.L. or S.T.O.L. craft in commercial use by 1979.

The most important plane to be completely disqualified by the regulations would be the supersonic transport. That plane requires a low-bypass ratio engine, for one with a higher bypass ratio cannot overcome its drag well enough to be an efficient user of fuel. The Concorde and the Tu-144 have bypass ratios of about 2:1, and that ratio will simply never have a rate of emissions low enough to meet the proposed rules. In contrast, the JT9D type of engine, the powerhouse of the 747, DC10, and L-10-11, has a bypass ratio of 5:1.

Mr. Sallee echoed Mr. von Kann's plea for more flexibility in the regulations, although he suspects that S.T.O.L. and V.T.O.L. planes were not foremost in their formulators' minds when the rules were drawn.—*J.K.*

Is the Arctic Fragile? That Depends

It depends on what you do to it, Max Dunbar (a Professor of Marine Sciences from McGill University) told the American Association for the Advancement of Science last December. Life cycles and processes in the arctic differ from those in more temperate climes, so the ways living things in the Arctic react to perturbations are different too.

One savior of Arctic ecosystems is simply their vastness—small disruptions will eventually be overwhelmed. Lemmings can be destroyed in one region, and will, in time, edge back into it from the lands nearby. But there must be time. Arctic creatures tend to have slower rates of metabolism and of growth, so as individuals and species both they respond more slowly to change than do more southern breeds. The char that swim in Frobisher Bay live to be 24 years of age or more, but they are 12 when they mature enough to reproduce. If a lake that far north is heavily fished for a few seasons, it can be emptied of fish because young are born too slowly to replace the catch.

For the same reason, heavy cutting is harmful to Arctic forests.

The Arctic has peculiar problems with spilled oil, Dr. Dunbar continued. The oil from a large spill will float under the ice and, one authority believes, emulsify into as much as 12 in. of water, to remain there indefinitely (others believe differently—see below). Getting at that emulsified oil would be hard. And we do not know its effects on birds and fish and plankton.

Yet Dr. Dunbar did not seem to feel the Arctic in general was as fragile as popular opinion supposed. We have all seen the holes and trenches that do not heal made in perma-frost by heavy machinery or vehicles, he said. They are spectacular. But they are also a special kind of damage, and workers up there now are careful to prevent them.

In asking if the Arctic is fragile, Dr. Dunbar comes around to two different definitions of stability for the two extremes of climate on the earth. An ecosystem that is considered stable in the tropics has little oscillation in its populations; it is complex in that it has a wide number of species and many routes of interaction and transfer of energy between animal and plant populations. Its overall use of energy is economic in comparison with the ecosystem of the Arctic.

The Arctic has far fewer species, either plant or animal, and fewer contacts between them. Stability in this system of extreme cold means that the system can perform great oscillations and continue to bear living things. And this, Dr. Dunbar says, requires vastness. And it requires only careful intervention by man, so he does not provoke oscillations that the system cannot manage.—*J. K.*

Oil and Ice

Max Dunbar (*see above*) spoke of how little we know of what happens when oil is spilled in the Arctic: how long it would take the bird populations to recover from a large kill; how long oil would persist in the cold sea; how it might be cleaned up; how the oil would react with Arctic ice. Two mechanical engineers from M.I.T., L. Stephen Wolfe and David P. Hoult, have been injecting oil into a tank of brine iced on the top with varying and controlled temperatures to get indications of the answer to the last question.

The test tank measured 12 in. in diameter and 42 in. in depth. This they believe was large enough to make a reasonable facsimile of sea ice. When the layer of ice had grown to 12-16 cm., they injected below it enough of either a North Slope crude or a No. 2 diesel to coat its lower surface with 1-2.6 cm. of oil.

In their experiments they found little mixing of oil and ice. The oil might climb into pores in the ice, often made by air bubbles, but nearly all of it remained below the ice. Eventually ice formed under the oil, so it was enclosed in a pocket until the ice was thawed. The oil would slow the forming of ice below it, however, as it insulated the brine from the colder air above. Brine and oil would separate upon warming.

If the researchers lifted the slab of ice from the tank before the layer of ice under the oil had formed, usually some of the oil clung to it in an uneven layer. But sometimes whole patches of ice would be free of oil, and in one run, none of the oil adhered. In that case, the oil was coldest, −14°C, and appeared to be frozen. How much oil clings to the layer of ice seems to depend on the type of oil, the coldness of the air and the brine, and the thickness of the ice (which influences the temperature changes in the oil). How quickly the oil spread under the ice

when it was injected depended on the same factors.

Drs. Wolfe and Hoult generalize from their data that if a supertanker carrying 100,000 metric tons spilled its load in the Arctic, the 113,000 cu. m. of oil would cover an area between 9 sq. km. and 45 sq. km.—probably about 17 sq. km. Their conclusions, they emphasize, apply only to new ice: that which is more or less permanent in the Arctic seas is fractured and fissured, and oil would behave differently beneath it.—*J.K.*

Putting A Hold On P.C.B.s

We have become aware in the past two or three years of a group of chemicals that resemble the D.D.T. family of pesticides in their persistence in the soil, in foodstuffs, and in animal tissues—and in the harm we suspect they can do to us. These chemicals are the polychlorinated biphenyls (P.C.B.s), and their use is harder to control because it is more diffuse and less obvious than the uses of the pesticides. Late last winter, however, the 22 member nations of the Organization for Economic Cooperation and Development (O.E.C.D.), including most of Western Europe, agreed to stop their use except in a few carefully specified and controlled ways.

P.C.B.s have two desirable properties in many industrial and commercial uses: they are nonflammable, and they are dielectric—capable of storing a charge but not of conducting it. They are used in capacitors of all sizes; as heat transfer liquids; as hydraulic fluids; in pesticides; as plasticizers in paints, copying papers, inks, adhesives; and in a number of other ways. The O.E.C.D. agreement essentially permits P.C.B.s to be used when they can be recovered: as dielectric fluids in large installations, as heat transfer fluids (but not in the processing of foods, drugs, or veterinary products), as hydraulic fluids in mining equipment, and as dielectric fluids in small capacitors (only as long as no substitute can be found). The member nations are to use P.C.B.s even in these applications only when their characteristic nonflammability is required.

A technical note attached to the announcement lists only two uses in which the chemicals are truly recoverable: as dielectrics for transformers and in large capacitors for power factor correction. These large installations use enough of P.C.B. to make its recovery economically attractive. Small capacitors, on the other hand, are so numerous in household appliances—hundreds in a television set, for example—and the quantity of the chemical in each is so small that recovery is pretty impractical. Japan has already ceased this use of P.C.B.s.

The economic effects of the ban ought to be slight. The O.E.C.D. countries do not import chemicals other than basic ones, and only six firms in the 22 nations even produce P.C.B.s. Five have already cut down their output. Use is measured among these nations in the tens—not hundreds—of thousands of tons. Member nations are requested to report to the organization and to each other on what they have used, manufactured, incinerated, substituted, and learned each year, beginning in 1974.—*J.K.*

METEOROLOGY

Instabilities in a Complex Fluid

Does the flap of a butterfly's wings in Brazil set off a tornado in Texas?

It is not a facetious question, for it was Edward N. Lorenz' way of phrasing one of the unanswered problems which confront weather forecasters: Is the behavior of the atmosphere unstable with respect to perturbations of small amplitude? And if it is, then how can a weather forecaster cope with the multitude of small events which may trigger such powerful forces as cyclones and tornadoes?

Dr. Lorenz, as Professor of Meteorology at M.I.T., has been pondering atmospheric stability—or lack of it—for several years. There is no direct way to study the issue, for the atmosphere does not permit a controlled laboratory experiment, he told the American Association for the Advancement of Science this winter: "If we disturb the atmosphere and then observe what happens, we shall never know what would have happened if we had not disturbed it."

So Professor Lorenz and his colleagues have resorted to simulations, letting a computer demonstrate how two different weather patterns might develop from two almost—but not quite—identical initial conditions. The result, he told the A.A.A.S., is "overwhelming evidence" that the atmosphere is so unstable that very small events may trigger very large ones.

Weather is a summation of a fine structure of local events—individual clouds, sea breezes, updrafts and downdrafts—and a coarser structure of high- and low-pressure cells and their associated turbulence. The latter can be reasonably well resolved; on this information, weather forecasters can predict the arrival of storms or sunny days 24 and even 48 hours in advance. Small perturbations in this coarse structure take several days to develop.

In contrast, the fine structure is hard to observe, and events in it tend to develop rapidly—in hours or less. Having attained "appreciable size," these largely unpredictable events then tend to induce equally unpredictable changes in the coarse structure, and sometimes the aforementioned forecasters are wrong.

This influence of fine structure on coarse is not the only reason. Those frustrations arise "mainly from our failure to observe even the coarser structure with near completeness," Professor Lorenz said. But the atmospheric instability resulting from the transfer of stimuli from fine to coarse systems may represent an ultimate limit for forecast accuracy.

The question about the butterfly was not idly chosen, for it raises two other peripheral problems:

☐ How far through any atmosphere can such a small event as a butterfly's turbulence have influence? No answer, yet—but there is a suggestion that its influence may spread very quickly in turbulent air but not in calm air.

☐ Dynamic properties of the atmosphere are very different in tropics and temperate latitudes. It's possible, thinks Professor Lorenz, that the butterfly's restlessness, which might spread many thousands of miles in a southern temperate zone, might never be able to cross through the tropical air at the equator to affect the northern temperate zone in which Texas lies.—*J.M.*

Speedier Computers

If weather systems are complex and nearly indeterminant (*see above*), imagine the complexity of computer programs designed to model them. True; indeed, weather system models used for forecasting now involve so many computations that weather can sometimes develop nearly as fast as current computers can forecast it.

The problem, described by Cecil E. Leith, who is on leave from the National Center for Atmospheric Research to be Visiting Professor of Meteorology at M.I.T. this year, is one inspiration for a new computer architecture.

Conventional computers are arranged with arithmetic and memory units in series; they are programmed to undertake one arithmetic operation at a time, solving problems in a linear, stepwise sequence. Though speeds of arithmetic units and memory access are very high, the speed at which electrical impulses can travel through conductors poses an absolute limit—to which advanced computers are in fact very near—on the time required for any arithmetic operation.

The next generation of high-speed computers will provide faster computation by using parallel arithmetic units, each with its own memory. Thus if a problem can be broken down into parallel subproblems (the solution of one not dependent on the result in the previous one), all these independent subproblems can be performed simultaneously.

The geophysical fluid dynamics problems which are the key to a better understanding of weather system development have such parallelism, and programmers are now busy devising ways to use the increased speed and capacity of the next generation of computers.

Will all this really make a difference? To double the resolution—accuracy—of any atmospheric model requires a 16-fold increase in computer capacity, Dr. Leith explained at a session sponsored by the Association for Computing Machinery during the 1972 convention of the American Association for the Advancement of Science this winter. Such doubled resolution increases by about one day—say, from three to four—the power of the model to predict weather with a specified accuracy.

That 25 per cent gain in forecasting power is surely worth the cost of the next generation of meteorologists' computer. But this is clearly a system of diminishing returns, thinks Dr. Leith; the fifth day will be less valuable than the fourth, for example, but it will be at least as costly. At some point we will simply have to face the hard facts of a cost-benefit analysis.

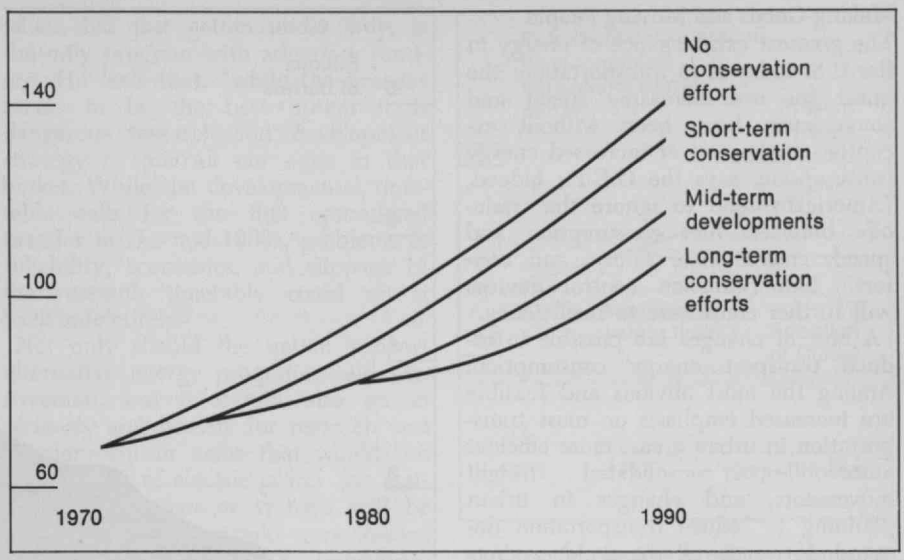
But a more important issue lurks: Can the weather data on which the predictive model depends—which in turn depends on the accuracy and extent of the sensing and communication systems—be similarly sharpened? And at what cost?—*J.M.*

ENERGY

Energy: Potential of Conservation

Can conservation temper America's inexorably growing hunger for energy? It can—if the disregard for energy consumption which has been bred into generations of Americans by low energy costs and ample fuel supplies can be reversed. Indeed, says a staff study of the President's Office of Emergency Preparedness, conservation is one of the strategies which will significantly moderate the "energy crisis" which seems to confront the U.S.

In the study published late in 1972 ("The Potential for Energy Conservation," U.S. Government Printing Office No. 4102-00009), the O.E.P. sets forth short-term measures which might by 1975 save 10 per cent of the energy now used in transportation, 1 per cent of that used for residential and commercial needs, perhaps 10 per cent of that used in industry; and 4 per cent of electric utility fuel requirements.



Present trends suggest that U.S. energy consumption may reach 140 quadrillion B.t.u./yr. by 1990. If fuels are growing scarce and our ability to provide energy in the future in increasing doubt, can this prodigious demand be reduced? It can, says the President's Office of Emergency Preparedness in a study completed last fall. The simplest conservation measures which could be taken immediately would cut some 5 quad. B.t.u./yr. from projected 1975 consumption and 10 quad. B.t.u./yr. from 1990 projections. If we start to implement them at once, new conservation measures would be ready by 1980 to save nearly 10 quad. B.t.u./yr. at that time, and O.E.P. proposes still further measures to become effective thereafter.

Mid-term measures which might be effective in the last half of the current decade would do better: additional savings of 21 per cent of presently projected demands for transportation energy, 14 per cent for residential/commercial consumption, some 15 per cent for industrial use, and another 4 per cent of utility requirements.

Even larger savings will be possible in the last 20 years of the 20th century: another 25 per cent of presently projected transportation energy, 30 per cent of residential/commercial energy, 15 to 20 per cent of industrial energy, and 3 per cent of utility demand.

If the country capitalizes on all the possibilities, we could reduce by half the new energy capacity now estimated to be needed by 1990; daily energy demand in 1980 could be less than that presently projected by the equivalent of 7.3 million barrels of oil. (Projected 1980 oil imports are between 9 and 12 million barrels daily.)

The most significant single measures are improved insulation of homes and office buildings, shifting transportation from aircraft, automobiles, and trucks to rail and bus, and use of industrial equipment and methods which are more energy-efficient.

Saving Fuel at Home

Residential represents some 19 per cent of all U.S. energy use, and more than half of that goes into space heating. Some conservation measures are obvious and require no capital investment at all: shut off lights and draw blinds in unused rooms, use appliances only when full loads have accumulated, keep everything in efficient working order, close dampers in unused fireplaces, and increase tolerance rates so that thermostats are set lower in winter and higher in summer.

Bigger energy savings could come from better home insulation. Already the Federal Housing Administration has significantly increased requirements on new homes to receive federally insured mortgages, and even beyond these requirements heat losses could be cut another 60 to 70 per cent for less than $900 of additional cost.

Increasing the efficiency of furnaces and appliances would yield significant energy savings (0.6 quadrillion B.t.u.) by 1980. If the power needed by a household electric refrigerator could be reduced by 20 per cent—which seems to be reasonable to O.E.P. with an increase of no more than 10 per cent in refrigerator price—some 100 trillion B.t.u. could be saved annually by 1980.

Simple and fairly obvious changes in the design of commercial buildings—architecture, ventilation, insulation, and lighting—could save 11 per cent of the forecasted total energy use by 1980.

Making Goods and Moving People

The greatest extravagance of energy in the U.S. today is in transportation; the quest for ever-increasing speed and convenience have been without exception at the cost of increased energy consumption, says the O.E.P.; indeed, "Americans tend to ignore the trade-offs between fuel consumption and speed, convenience, safety, and confort." New emission control devices will further contribute to inefficiency.

A host of changes are possible to reduce transport energy consumption. Among the most obvious and feasible are increased emphasis on mass transportation in urban areas, more efficient automobiles, consolidated freight movements, and changes in urban planning to reduce transportation demand. If we do all we could, savings of over 1.3 quadrillion B.t.u.'s are possible by 1975, additional savings of 2.5 quadrillion B.t.u.'s by 1980 and 7 quadrillion B.t.u.'s before the year 2000.

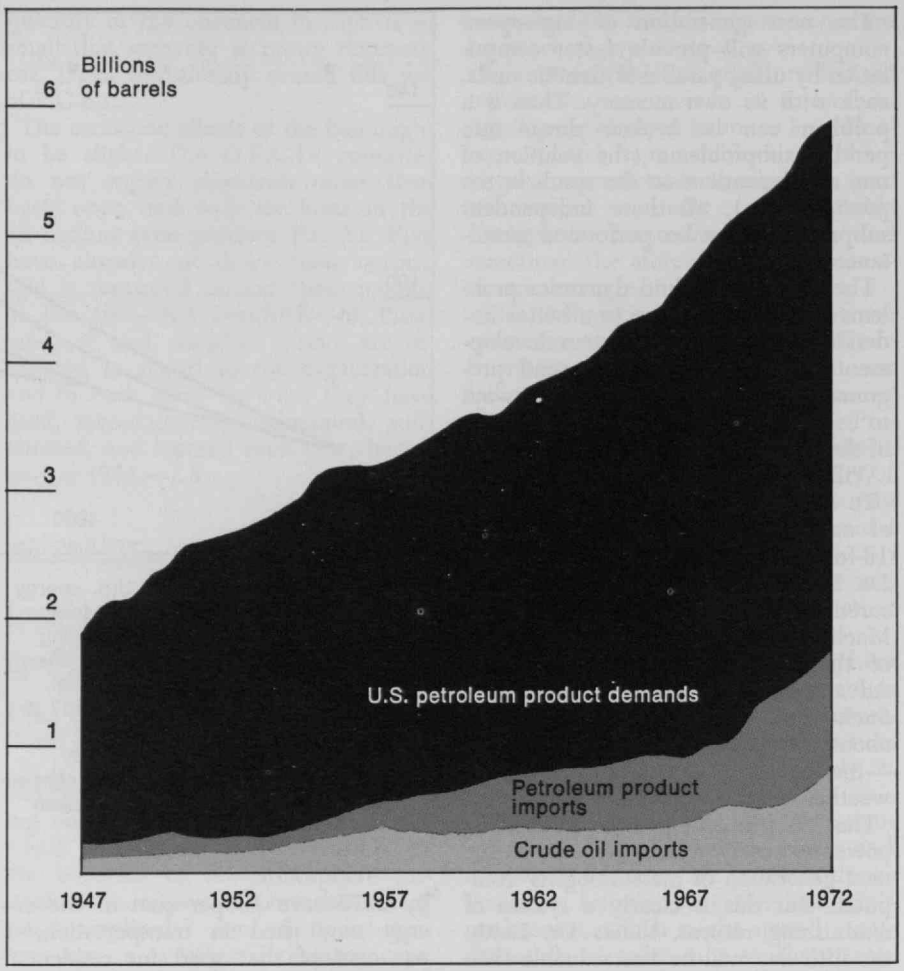
Industrial users' records on energy efficiency are good; in almost every manufacturing field, energy use per dollar of value added has decreased since 1962. The exceptions are tobacco, textiles, apparel, lumber and wood, and printing and publishing. But even industry could do better—and cut its demand 10 to 15 per cent by 1980—by accelerating its retirement of old equipment, designing more energy-conscious processes (including recycling and reuse of materials and product design changes to increase product lifetime), and upgrading and maintaining its equipment better.

Can the utilities producing electricity increase their efficiency of energy conversion? Yes, although the O.E.P. admits that "there are essentially no means for major improvements in efficiency of the modern fossil-fired steam turbine cycles at the current state of metallurgy technology." Suggestions rest on successful efforts to smooth out the daily demand cycle and to better utilize waste heat and on such new technological developments as combined-cycle and nuclear breeder plants and cryogenic generation and transmission.

Raising the Price

With so many savings possible and obviously desirable, how can they be achieved? The O.E.P.'s route to that answer is through the consumer's pocketbook. "Although there is considerable uncertainty about the price elasticity of energy as a whole," says the report, ". . . a price increase . . . may be understood as one of the possible means of implementing many of the suggested conservation measures." Indeed, the residential and commercial savings "will only be obtained if energy becomes much more expensive, or some other strong incentive for conservation is created." And in discussing industrial energy consumption, "It should be emphasized that underpriced energy encourages wasteful energy use."

The environmentalists' approach to energy issues may be a two-edged sword. While the O.E.P. admits that "environmental programs . . . possess a mechanism for public examination of the effect on energy consumption of energy conservation measures," environmental programs offer "no attractive possibilities for significant energy savings in the next five years." Indeed, the contrary may be true in a number of cases where (as in automobiles) environmental controls will act to reduce efficiency.—*J.M.*



The United States demand for petroleum products has tripled in the past 25 years. In this period petroleum imports have grown under the tight U.S. quota from 8 per cent to 21 per cent of the total. The author feels that the imports are not sufficient, that shortages can be averted by eliminating the quota system. He also would stockpile supplies.

On Lifting Oil Import Quotas

While praising the federal government's recent elimination of the oil import quota, President Nixon's former energy advisor says he is disappointed in most of the rest of his old boss's energy announcement of last April. S. David Freeman, now Director of the Ford Foundation's Energy Policy Project, gives much of the credit for getting rid of the "14-year-old quota mess" to Treasury Secretary and President Counselor George Shultz.

In an interview, Mr. Freeman (who emphasized that his views were personal) said it was important to end what has been called the "drain America first" policy. Through the 1960s domestic fields produced 88 per cent of the nation's oil supplies. In that innocent decade there was spare capacity; everyone was relaxed about energy resources and oil import quotas were viewed as a domestic issue. Just over 25 years ago about 8 per cent of the crude oil and petroleum products the U.S. used was imported. By last year, the percentage had crept up to 21. Yet until the President's action last April, imports were tightly controlled by quota.

If oil could have been purchased

freely on the world market during the past two or three years, could the various fuel-drought pockets—such as Denver last winter—have been averted? Very likely, Mr. Freeman said. He believes that without a federally imposed absolute import quota, U.S. dealers probably would have secured enough fuel oil to meet the demands of unanticipated severe winter spells anyplace in the country.

The East Coast, which now depends on imported oil, rarely has more than a three-day supply, even in the dead of winter. In Europe the rule is 60- to 90-day stockpiles—enough to carry them through a winter even if all the world's oil field workers were out on strike. With oil still available on the international market, Mr. Freeman would have the U.S. accumulate a European-size reserve, which he feels could be done in a year or two. The psychological relief alone would be worth the investment.

As to the rest of the President's energy message, Mr. Freeman says there was little in the way of new action: "I would have hoped there would have been more on conservation and research. And the question of how to deal with shortages this summer and next were not taken up. That is disappointing."—*R.S.*

. . . And The Conservation of Fuel

Opening the sluice gates to foreign oil (see above) will allow the United States to maintain its high-energy ways for no more than a few decades, and then only if the stuff is treated as a treasured resource, Mr. Freeman continued.

Are we, as a society, beginning to conserve our energy? There is certainly enough talk about it—and in some key places. Senator Henry M. Jackson (D-Wash.) has introduced legislation putting a horsepower tax on automobiles. And in an extraordinary bit of testimony before the Congress this winter, Fred Hartley, President of the Union Oil Company, said he was in favor of a minimum-miles-per-gallon statute. "When you get this kind of talk," Mr. Freeman remarked, "you can't discount the possibility that the country is moving in the direction of conservation."

Suppose a set of effective conservation practices manage to hold off the energy crisis for a while. That will give us time—not much to spare—to figure out how to enter the 21st Century with a clean and sufficient supply of power.

But we've got to start now, Mr. Freeman said. The liquid metal fast breeder reactor project, the second version of which has just gotten under way, is the only program with adequate funding. He feels that, "while the breeder seems to be the best option it is dangerous research and development strategy to put all our eggs in that basket. While the developmental timetable calls for the first operational breeder in the mid-1980s, problems in reliability, economics, and slippage of the research timetable could set it back indefinitely."

Not only should the nation support alternative energy programs, said Mr. Freeman, but it should also go in seriously and heavily for research and development in areas that would use new sources of electric power (no matter which system or systems will be generating it). He would work toward electrifying the nation's transportation system. And take the problem of the transmission of power: "If we don't do enough work on undergrounding transmission lines and developing a superconducting transmission technology, we might find ourselves with perfectly fine power plants and not enough land on which to build a grid to get the energy to where it is needed." A broad, systematic approach to energy and related problems would indeed seem a rational way to go.—*R.S.*

Gas Consumption: Down?

With the gradually forming battle lines between the automobile and clean air as a background, William D. Ruckelshaus, Administrator of the Environmental Protection Agency, who could hardly have considered himself in "friendly territory" made some observations on the use of gasoline to the annual conference of the Highway Research Board in January. Emission controls required for 1975 automobiles may increase gasoline consumption by as much as 7 per cent, he said. But the cost of regaining that disadvantage may not be so severe after all:

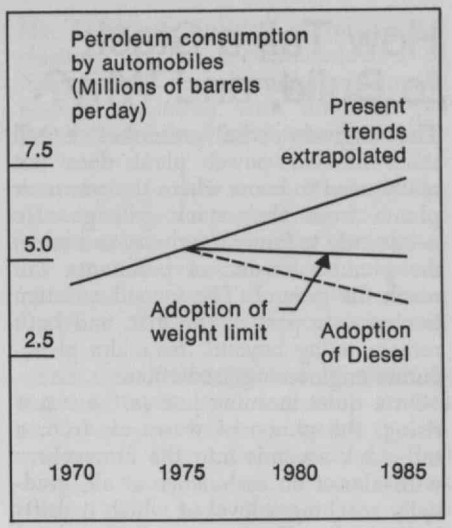
☐ Air conditioners reduce gasoline mileage 9 per cent on the average and up to 20 per cent "on a hot day in urban traffic."

☐ The typical automatic transmission increases average fuel consumption by 6 per cent.

☐ Steel-belted radial tires can save 10 per cent on gasoline mileage.

☐ An increase of 500 lbs. in car weight reduces mileage by as much as 14 per cent. According to E.P.A. studies, a 3,000-lb. car uses one gallon of gasoline to go 16.2 mi. on the average, while a 3,500-lb. car will go only 14 mi. A 5,000-lb. vehicle consumes twice as much gas as a 2,500-lb. one.

Indeed, automobile size and weight provide a powerful leverage on the nation's gasoline consumption. "A drop from the present average weight of the automobile to a 2,500-lb. minimum would reduce total gasoline consumption in 1985 to the projected level for 1975," Mr. Ruckelshaus told the Highway Research Board. The result would be to reduce crude oil imports projected for 1985 by 2.1 million barrels a day, cutting the balance-of-payments deficit projected for that year by $2.3 billion at current prices.—*J.M.*



Automobiles used 4.3 million barrels of petroleum per day in 1970 in the U.S. They contributed 66 per cent of our CO emissions, 40 per cent of NO_x emissions, and 90 per cent of atmospheric lead emissions—over 120 million tons of pollutants a year. If we had had no automobiles in 1970, we would have avoided spilling 7.5 million gal. of petroleum and 600 million gal. of spent crankcase oil, and there would have been 3.4 million tons less of air pollutants from refineries. But Robert L. Sansom, speaking to the International Automotive Engineering Congress in Detroit, used the figures more for dramatic effect than because the implied goals are realizable for any modern society as we know it.

But Mr. Sansom had two interesting suggestions: if diesel engines (fully able to meet 1975 emissions standards with a 75 per cent increase in fuel economy) were used in all cars starting in 1975, crude oil consumption by automobiles in 1985 would be less than it was in 1970. (What about a rotary engine? No way, said Mr. Sansom: "an estimated 35 per cent loss in fuel economy.") If the average weight of automobiles were reduced to 2,500 lbs. after 1974, oil consumption by 1985 would be less than in 1975. And if the two effects can be assumed to be additive, said Mr. Sansom, the combination introduced in 1975 "could potentially reduce automotive fuel consumption in 1985 to the lowest level since 1964."

How Tall a Stack to Build, and Why?

The engineer who prescribes a tall stack for his power plant does not really need to know where the warm-air plume from that stack will go. He needs only to know if, where, and when the plume's burden of pollutants will reach the ground. The second question is obviously part of the first, and both remain today beyond the realm of accurate engineering prediction.

On a quiet morning just as the sun is rising, the plume of warm air from a tall stack ascends into the atmosphere with almost no turbulence at all, gradually reaching a level at which it drifts horizontally. Engineers call that level the "effective stack height"—the height at which the plume and its pollutants begin to disperse.

As the sun rises its energy delivered to the earth gradually increases. Perhaps two-thirds of the sun's energy falling on the earth is absorbed by it; one-third is reflected back into the atmosphere where it establishes a layer of turbulent motion. As solar energy accumulates during the day, the turbulence affects first a thin layer, later a thicker one. When—perhaps by noon—the top of this turbulent layer reaches the top of the stack, the orderly plume of effluent is suddenly disordered; the "effective stack height" is suddenly reduced and the pollutants are discharged much nearer the earth and may in fact fall back onto it. As the earth cools the turbulence subsides and effective stack height rises again.

This scenario, revealed by wind tunnel tests, theory, and correlation of field data at the Massachusetts Institute of Technology and described this winter for a group of industrial visitors by David P. Hoult, Associate Professor of Mechanical Engineering, shows that ground-level pollutants from tall stacks must be measured at many different times of day. And the theory which underlies these observations lets engineers determine the relationship between the effluent temperature and the effective stack height for any particular plant.

But the problem is seldom so simple, warned Dr. Hoult. There remains "a whole class of anomolous cases," he said: determining the effective height of a stack in a valley over which a wind is blowing is one example.

And there also remains a class of questions about what happens to pollutants as they disperse from the plume. Tall stacks are built so that combustion products are delivered high enough above the earth to be carried away from population centers, and in some cases to be neutralized by natural processes, before they fall onto the land. But in the case of sulfur dioxide, which appears in stack gas as a result of sulfur in the fuel, no one can be sure: too little is known about the half-life SO_2 in the atmosphere and about the effect of dust and humidity. Theory has only begun to reduce these questions to practice, said Professor Hoult.—*J.M.*

Power Siting Policy

Consolidated Edison of New York first applied to the Federal Power Commission to build a generating plant at Storm King Mountain on the Hudson River in 1962. Three years later the F.P.C., having processed the application, granted the necessary license. But in 1965 the Second Circuit U.S. Court of Appeals, petitioned by the Scenic Hudson Preservation Conference, set aside the license and asked for further study. Three years later the F.P.C. was again ready to approve, but New York City asked for still further study with respect to the safety of its water supply. This completed, the F.P.C. in August, 1970, was again ready to grant the license. Thirteen months later the Court of Appeals, having again been petitioned to overturn the decision, announced in favor of Consolidated Edison. The question was then put to the U.S. Supreme Court, which in June, 1972, refused to reopen the case.

But even now the story has not ended; construction of the plant is enjoined—ten years after it was first planned—in response to petitions before the New York State courts.

Representative Clarence J. Brown (R.-Ohio) recalled this history for members of the American Society of Mechanical Engineers last winter as an example of "the burden of sophisticated and costly guerilla warfare" which "continues to confront every proposal for siting and construction of needed electric power facilities across the country."

Can power plant siting problems be simplified—while due protection is nevertheless retained for those whose legitimate interests may be jeopardized?

Representative Brown thinks so, and to support his view he referred A.S.M.E. members to the Nixon administration's Power Plant Siting Act of 1971. Its purpose, he said, was "to bring long-range planning, review, certification, and licensing procedures under a comprehensive, workable umbrella."

Basically, the bill suggested that power plant and transmission line applications be considered five years in advance of proposed construction and in the context of ten-year system development plans. State siting agencies authorized and equipped to certify detailed construction plans would be asked to do so two years in advance of construction. A largely similar bill, providing in addition for three-member mediation or arbitration boards to settle disputes, was introduced by Representative Torbert H. MacDonald (D.—Mass.).

But Congress adjourned without taking action after the House Commerce Committee reached an impasse in its debate of the proposals. Bringing administration support to the Committee hearings, Commissioner James T. Ramey of the Atomic Energy Commission said power plant construction delays can cost as much as $50,000 to $100,000 a day, considering lost revenues, interest on construction loans, the cost of purchasing power, and the time spent by professionals to resolve whatever issues are at stake.

Without a national siting policy, Representative Brown told A.S.M.E. members, the problems "stand to become even more involved and time-consuming as new laws and regulations are enacted and adopted at all levels of government."—*J.M.*

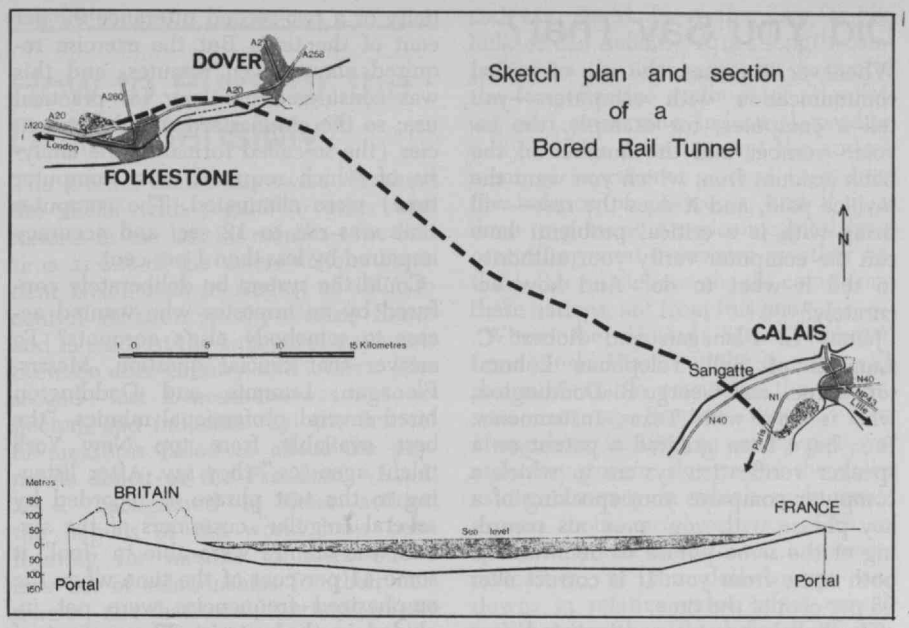
TRANSPORTATION

A 170-Year-Old Idea Comes to Fruition

"You may tell the French engineer that if he can accomplish the tunnel I will give him my blessing in my own name, and in the name of all the ladies of England."—*Queen Victoria, writing to her ambassador in Paris, after receiving Thome de Gamond at Buckingham Palace.*

The Queen never blessed the French engineer, because the tunnel was never completed. Perhaps the present Queen will, for after 105 years it will be. Agreements signed last fall between England, France, and an international consortium of financiers are now supporting more feasibility studies, and later this year, the French and English governments are expected to give their formal approval to what is considered the largest privately financed public-interest project in history: a Channel tunnel, the first man-made link between continental Europe and England.

The tunnel is expected to cost just under $1 billion dollars and to take over five years to build. Travelling time between London and Paris will drop from four and one-half hours to less than three. The train-only tunnel (cars were ruled out because of their pollution and low capacity) will consist of twin 20-ft.-diameter tubes and a smaller service tunnel. They will be bored through 23 miles of chalk as much as 160 feet under the channel bed. Electrified freight and passenger



This is the final map for the Channel Tunnel—essentially the same route as was suggested by M. Desmarets over 200 years ago. Groundbreaking should be this fall. The financing is from private sources—an arrangement unique in such massive construction for public use.

trains will operate 24 hours a day with peak service as frequent as every 5 to 10 min. Automobiles will travel on flat-bed freight cars.

The project has come a long way since 1957 when Frank Davidson, now a senior research associate at M.I.T., among others became interested in the tunnel and ways to finance its construction. Mr. Davidson believes the agreement of the international banking community to finance its construction with private capital provides the real measure of the tunnel's importance. Among the international supporters Mr. Davidson believes especially important are Earl Alexander of Tunis, who had been the head of Her Majesty's Navy; Earl Mountbatten of Burma; Louis Armand, former chairman of the French National Railroad; and René Massiali, the Secretary-General of the French Foreign Office.

Mr. Davidson points out that the technology of the project was fairly routine a century ago, when Colonel Beaumont's air-driven boring machines—direct ancestors of those used today—drilled through a mile of chalk from both the English and French coasts. These unfinished borings are still structurally sound, and recent surveys and borings of the channel bottom have only confirmed the original French geological surveys made 100 years ago. Indeed, the first concepts for a channel tunnel surfaced in France in 1751 when the Academy of Amiens offered a prize for the best design for a permanent link between England and France. A then-unknown young geologist, Monsieur Desmarets, won because he correctly guessed that the chalk stratum was continuous to Calais to Dover. His plan for a tunnel is essentially the one to be used today. "You might say the Channel Tunnel has had more than 200 years of research and development," Mr. Davidson says.

He sees the tunnel not as a triumph of technology but as an example of how private investors can be marshalled to finance large projects of great public importance. "We're only beginning to explore this in the United States," he says. "This is different from putting up venture capital . . . from simply getting the project started. To button down this sort of large project you need some certainty that the investment is protected."

To this end, Mr. Davidson adds, the organizers contracted for traffic and revenue studies using consultants from England, France, and the U.S. Even conservative estimates projected high traffic flows. This ensured that revenues would cover debts and that the lender's investment would be protected. Oil pipelines, he says, are financed similarly: "If you want to build a pipeline you get an assurance of how much oil will flow through the pipeline. . . . Likewise, buildings can be leased ahead of time to justify their financing."

The studies used to prove the tunnel's engineering feasibility also improved the climate for private investment, says Mr. Davidson. Instead of relying exclusively on the recommendations of independent consultants, the tunnel's backers consulted with some of the same companies that might eventually be involved in the construction. The size of the project meant that only the most prestigious engineering and construction firms could bid for the work—a further assurance to private investors. Mr. Davidson calls the whole business "a blend of innovative procedures and stodgy traditional financing."

The overall coordination of these financial, legal, and technical studies until last year has been under the direction of the International Channel Tunnel Study Group, whose efforts since 1957 now permit the hope of a 1973 ground-breaking.—*Michael Chiusano*

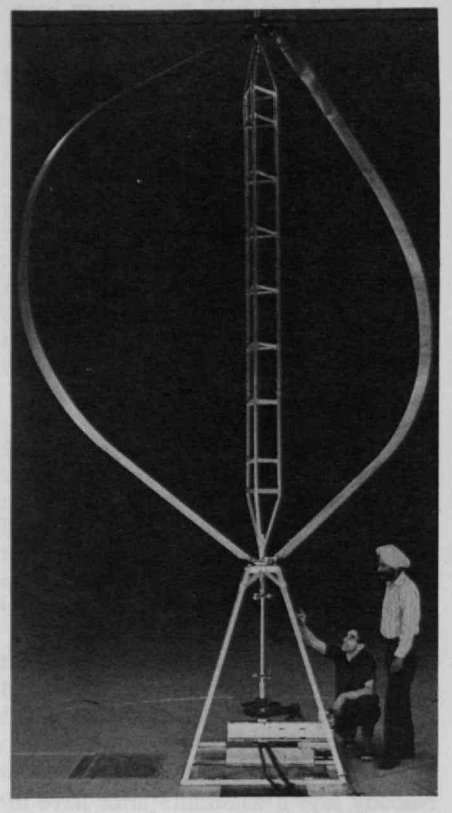
DEVICES

Try and Catch The Wind

Nobody says a windmill's arms have to travel up and down and around as they traditionally do. In fact, when they do, someone has to keep moving them about so that they catch the wind. But if instead of moving up and down, the arms whipped around a slender stalk, the whole affair would be more practical, and windmills might again be economical purveyors of power.

Two Canadians, Raj Rangi and Peter South, designed the vertical axis windmill in the picture on page 52 as a cheap way of catching a natural force, wind, and changing it into mechanical or electrical power for developing countries or isolated areas of developed ones. The two work in aeronautics for the National Research Council of Canada, in whose *Science Dimension* for October, 1972, can be found a report of the windmill. The rotor consists of two or three convex metal blades of aerofoil cross-section attached to the vertical shaft, supported on ball bearings at the top and bottom and held with guy wires at the top, the magazine says. The wind turbine, being a vertical axis machine, is omnidirectional, eliminating the heavy gearing, heavy shaft, and the complex mechanical devices that keep conventional windmill sails facing the wind.

Of its output, Mr. Rangi says, "Wind travelling at 22 feet per second (15 miles per hour) that strikes a 15-foot diameter wind turbine will produce 1.2 horsepower or 0.9 kilowatt." At their hub, the blades turn at a low peripheral speed, but the speed at their tips can be six times that of the wind driving them. At their best in, say, a 15 m.p.h. wind, the blades revolve



Two Canadians, Raj Rangi and Peter South, show their new design for a windmill. Conventional ones must be faced into the wind, and need human attention or complex mechanical devices for direction, but this one sidesteps that problem. Its designers believe it will convert natural into mechanical energy for less mechanized and electrified regions. Once they or someone else finds a way to store the gathered energy, the windmill will be even more useful. (Photo: Bruce Kane, for *Science Dimension)*

around their core 170 times per minute.

The wind power available throughout the world, *Science Dimension* reports, is believed to be equivalent to 100 billion watts per year, worth $500 million Canadian dollars at Ottawa rates. Mr. South and Mr. Rangi believe their simple turbine is an economically reasonable way to use it. The fixture itself is not costly. What must be found next, however, is a cheap and efficient way of storing energy from the windmill for those times when the wind does not blow, for that would make the device not only a practical but a consistent source of power.

When they had built their windmill, they found (through the Patents Office) that a device almost identical to it had already been designed and patented in France and the United States in 1931—that patent has expired without fame. Perhaps the 1970s will be more receptive to this modest collector of natural energy.—*J.K.*

Did You Say That?

Whenever it comes, the era of verbal communication with computers—you tell a computer, for example, the invoice number and the number of the bank account from which you want the invoice paid, and it does the rest—will bring with it a critical problem: how can the computer verify your authority to tell it what to do? And how accurately?

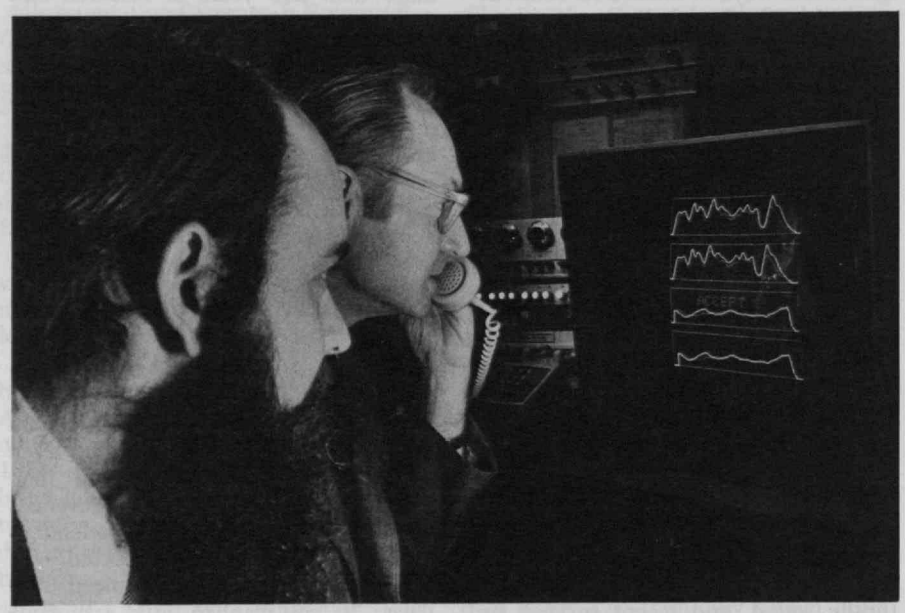
James L. Flanagan and Robert C. Lummis of Bell Telephone Laboratories, Inc., and George R. Doddington, who is now with Texas Instruments, Inc., have been granted a patent on a speaker verification system in which a computer compares your speaking of a key phrase with your previous recording of the same phrase to determine if both come from you. It is correct over 98 per cent of the time.

The Bell Laboratories scientists began by equipping their computer to analyze the spoken phrase for five characteristics which are then compared with those of the recorded phrase: the lowest three emphasized sound frequencies, which are a function of shape and manipulation of the speaker's voice box and mouth; the voice pitch, governed by the vibration of the vocal chords; and the variation of sound intensity with time. The computer was prepared to adjust for differences in the speed and rhythm of speaking, since no one speaks at the same rate twice.

Using all this data, the computer was correct in its estimate of the authenticity of a two-second utterance 99 per cent of the time. But the exercise required about seven minutes, and this was considered too long for practical use; so the emphasized sound frequencies (the so-called formants, the analysis of which required most computer time) were eliminated. The computer time was cut to 12 sec. and accuracy impaired by less than 1 per cent.

Could the system be deliberately confused by an imposter who wanted access to somebody else's accounts? To answer that crucial question, Messrs. Flanagan, Lummis, and Doddington hired several professional mimics, "the best available from top New York talent agencies," they say. After listening to the test phrase as recorded by several "regular" customers of the system, the mimics were able to "fool" it some 41 per cent of the time when the emphasized frequencies were not included in the criteria, 27 per cent of the time when the formants were used. The scientists admit that these "miss rates" are high, but they insist that no impersonator would enjoy the unusual advantages given the mimics to listen to the recorded statement and record their own for comparison with it as often as they wished.

They are confident that speaker verification will be improved; "there is every indication," they say, that speaker verification will be perfected and that conversations between users and a computer can soon be "a major step in extending the convenience and utility of the telephone."—*J.M.*



James L. Flanagan, Head of Bell Telephone Laboratories' Acoustic Research Department, is talking to the computer, which is displaying its comparison of his speaking of a key phrase compared with his earlier recording of the same phrase stored in the computer's memory. Dr. Flanagan, Robert C. Lummis (left), and George R. Doddington have been granted a patent on this speaker verification system; it now has an error rate of less than 2 per cent, and they are confident that further improvement is possible.

How to Plan for the Dollar Sensibly?

The United States has twice devalued the dollar with regard to other currencies in the last 20 months—the first time as one of the severe actions President Nixon took in August of 1971 to control inflation in the United States and to readjust the balance of payments between this country and others. The second—last December—was not expected, and indicates that the first set of measures failed to affect the payments deficit as the President wished. As a background to these actions, the nations of the world have been meeting for months to work out a new set of relationships for their currencies, one that would perhaps relieve the dollar from being the currency in which monetary reserves are expressed.

What is ideal in a solution is not necessarily practical, so in the Fall, 1972, issue of *Sloan Management Review* (pp. 1-16) Representative Henry S. Reuss (D-Wis.) and economist John R. Karlik, who is on the Congressional Joint Economic Committee, discussed what alternatives ought to be considered and which are politically possible.

One of the questions that obviously needs resolution is how rates of exchange between currencies can be adjusted routinely without wild fluctuations in them and without massive and sudden devaluations of currencies. Several kinds of mechanisms have been suggested, both automatic and discretionary (an example of a discretionary one was that from Franco Modigliani and Hossein Askari reported in *Technology Review*, December, 1971, p. 70). A means and a time of adjustment that could be determined for each major imbalance separately is attractive, the authors write, because of "the difficulty of constructing a set of indicators that would be accepted as invariably being correct." The automatic method is also appealing because of "the ability of political authorities to postpone necessary adjustments." They continue: "Given the currently weak external payments position of the United States and the difficulty the U.S. has had in persuading surplus countries to increase the exchange value of their currencies," U.S. negotiators will probably try to get a mechanism for adjusting exchange rates that is basically automatic.

United States policy makers must also decide how much of the trade deficit ought to be rectified by modifications of the exchange rates and how much by restrictions on trade and the flow of capital out of the country. Mr. Reuss and Mr. Karlik favor the first for the bulk of the deficit: "Arm's length competition with other countries is one of the few effective methods of stimulating and preserving industrial productivity." They do not accept the curtailment of investment abroad to redress the balance of payments, and if it is done to prevent American capital from controlling vital industries in other nations, the restrictions should come from those nations, not from this one.

When the United States emerged from World War II as the country with the most stable economy, the nations who met at Bretton Woods, New Hampshire, in 1944 to set up post-war monetary policies designated the dollar as the currency in which each would express its financial reserves. This responsibility has exacerbated its present difficulties, as the dollar's ups and downs in relative value affect considerably more than the balance of payments in international trade. In fact, foreign central banks last fall held more than $45 billion in accounts that draw in some way on the United States treasury, and they are required to absorb more if our deficits continue.

This is one impetus to changing the reserve currency to Special Drawing Rights (S.D.R.'s) on the International Monetary Fund as the authors believe will happen. As Mr. Karlik and Mr. Reuss write, "The ability of the United States to finance payments deficits through the accumulation of dollar liabilities to foreign central banks [has come] to be viewed as a license that [can] not be permitted to remain effective indefinitely."

If the decision is made during the present talks to relieve the dollar from being the reserve currency, the nations have one large question to answer: "How S.D.R.'s shall be substituted for dollars and what obligations the United States shall assume as a consequence. . . . Should the United States be obliged gradually to amortize its debt to the I.M.F., or should the U.S. be indebted perpetually and allowed to pay interest indefinitely, with no expectation that its obligations eventually will be retired?" The U.S. naturally wants any arrangements to be lenient, the authors write, and the other nations might actually favor something like the latter alternative: "Since any amortization of this debt would necessarily be the consequence of payments surpluses with the rest of the world—a large part of which would probably be accounted for by trade surpluses—foreign authorities have little apparent motivation to insist upon amortization."

If Special Drawing Rights are made the reserve asset for the I.M.F. nations, more must be created to assure enough international liquidity. But how shall they be put into use? New issues have been distributed by a quota system whose design was "a completely political compromise." Most go to countries with strong economies; only about one-third to developing countries. The developing nations are displeased. Mr. Reuss and Mr. Karlik believe that they should get a greater share; this would give these nations currency with which to buy from the others capital goods they could not otherwise. The bulk of the S.D.R.'s will accrue to the developed nations in time anyway, but more goods and services would be transferred from richer to poorer in the process.

The United States cannot avoid leadership in monetary reform—it is simply too big. So Mr. Reuss and Mr. Karlik plead that it be generous and far sighted in its leadership. But, they write, "The tactic of making limited sacrifices . . . appears to run counter to the current Treasury rhetoric of hard bargaining, compensation now for the supposedly unreasonable burdens borne by the United States in the past, and no more trading with 'one hand tied behind her back'."—*J.K.*

Materials—Going Up

John F. Elliott grew up in a small town in northern Minnesota. A favorite Sunday excursion was to the great open-pit iron mines of the nearby Mesabi Range. It seemed simple, then: an immensely rich ore awaited the shovels, and the men who worked it and county from which it was taken were made rich.

As Professor of Metallurgy at M.I.T., Dr. Elliott now knows that it is not so simple: the great Mesabi Range is no longer rich, foreign steel is an increasing factor in the American market, and leaner raw material shares with recycled material a market which is no longer so secure.

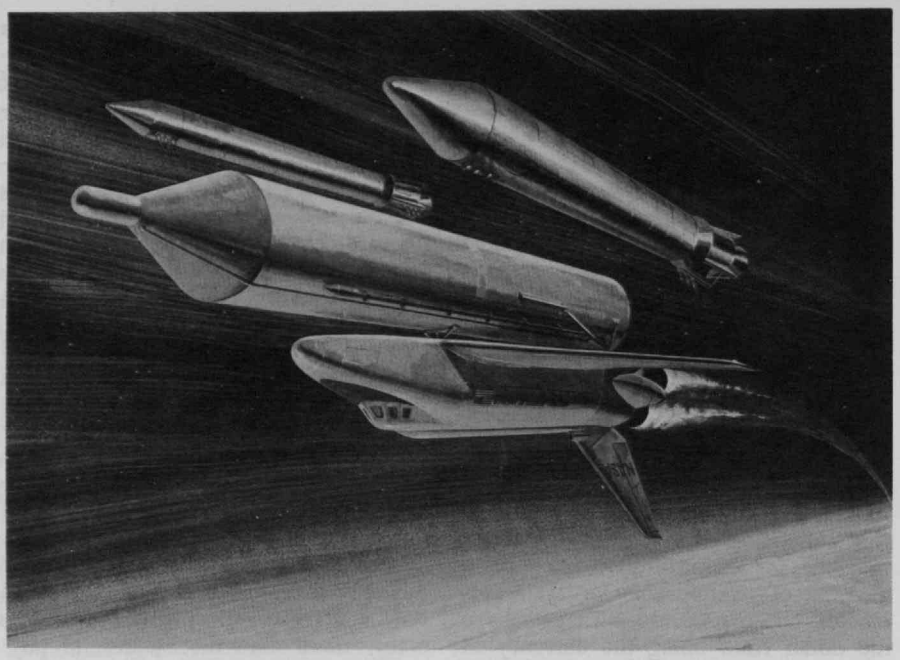
Looking simply at raw material supplies, it is easy to argue that there is nothing but trouble ahead for the U.S. —and ultimately for the world (*see* Technology Review *for December, 1972, p. 54*). Certain it is that foreign production of ores and metals is increasing at a rate far faster than U.S. growth—and that the U.S. is increasingly dependent on imported materials.

But this is too simple a view, Dr. Elliot told a seminar at M.I.T. this winter. Most metals are produced with some combination of new and recycled material. In a period of rapidly increasing production recycled material is scarce in relation to production, and the advantage lies with those whose ore bodies are best. Then the price of ore goes up: suddenly, recycled materials become more attractive. But at the same time ore reserves hitherto con-

sidered too poor to be economic are added to usable reserves. But extensive use of recycled materials—which tend to be labor-intensive—pushes up the cost of labor, and the emphasis is back once more on new ore.

Nor is it yet so simple, for nowhere is there a totally free market for metallurgical materials. Differential freight rates for ores and scrap, depletion allowances set arbitrarily by taxation, and recycling incentives built into environmental policy are among the ways through which government now influences the market—and will probably continue to do so in the future.

Like death and taxes, says Professor Elliott, only two things are certain in the metals business: growing demand and higher prices. Growing demand, because many underdeveloped nations are about to enter the market as substantial consumers of metals. Higher costs relative to other prices because, though there are strong forces to increase our potential for producing metals inexpensively, still stronger forces are working in the other direction. Two factors will ultimately be decisive: the rising costs of energy and the cost of new environmental safeguards.—*J.M.*



An A.I.A.A. committee assessed ideas for new space transportation systems, and gave its findings to the association's annual meeting in January. Naturally Topic A was the shuttle: the scheme that N.A.S.A. plans and its uses. A shuttle system ought to be built, the committee felt—but one far more complex than what N.A.S.A. is funding. Present N.A.S.A. plans include the craft shown above: the shuttle, its two reusable external boosters, and an expendable external fuel tank. The craft will land with its insignia right side up. (Photo: N.A.S.A. from North American Rockwell)

MOON AND STARS

Trans-Iron-Curtain Interferometer

The finest angular resolution ever attained at interstellar distances has been reported in an experiment measuring galactic clouds of water vapor.

The targets measured by the observations were water masers, identified by their strong emission of radio waves characteristic of hydrogen ions, in the nebulae known to astronomers as W3 and W49. Both are part of our own Milky Way galaxy, W3 being 6,000 light years away and W49 being 45 million light years distant. The measurements were made by the first trans-iron-curtain interferometers ever attempted—between M.I.T. astronomers at the Haystack antenna in Westford, Mass., and U.S.S.R. astronomers at the Crimean Astrophysical Observatory in Simeiz. The very-long-baseline interferometer (V.L.B.I.) made possible measurements with an accuracy of about one part in 600 million—comparable to distinguishing a golf ball at a distance of 6,000 miles.

Results of the joint experiment were reported in a recent issue of the *Russian Astrophysical Journal*, and a translation will soon be issued in this country. The team of 15 scientists was composed of five groups from the two countries. Senior scientists were Bernard F. Burke, Professor of Physics at M.I.T.; Leonid I. Matveyenko, of the Institute for Space Research in Moscow; Ivan G. Moiseev, of the Crimean Astrophysical Observatory in Simeiz; Steven H. Knowles, of the Naval Research Laboratory in Washington, D.C.; and James M. Moran of the Smithsonian Astrophysical Observatory in Cambridge, Mass.

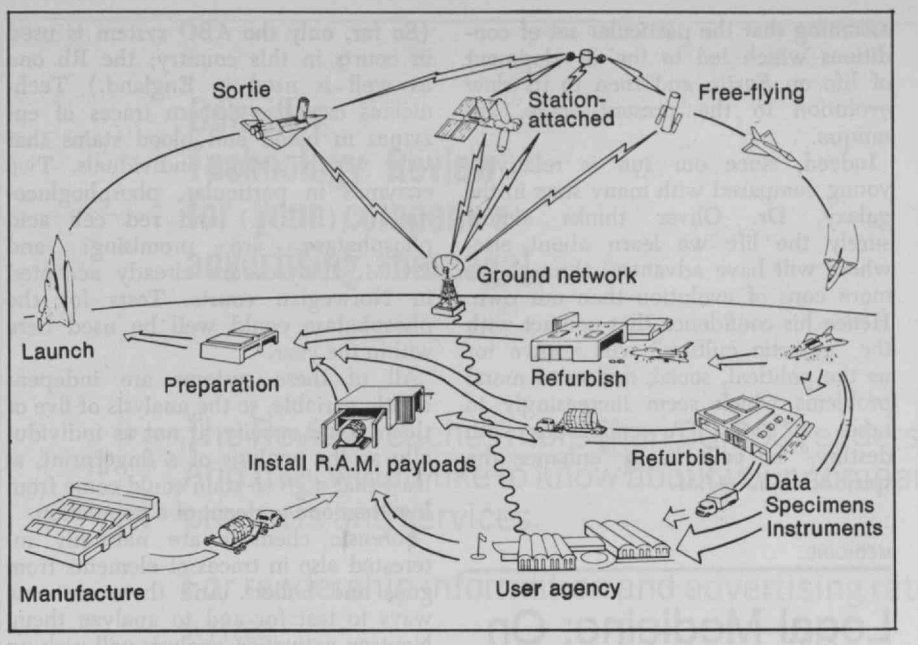
The technique of V.L.B.I. is based on signals received at two radio telescopes from the same radiating celestial source. The signals are superimposed and the resulting interference patterns allow the size and shape of the source to be determined. The longer the distance between the two telescopes, the finer the resolution that can be achieved, and thus the smaller the objects that can be detected at a given distance. The base line used by the Russian-American team was some 6,000 miles long. Because the technique depends on phase differences between two high-frequency signals, timing is the critical aspect of V.L.B.I. experiments.

To obtain the necessary precision in timing, Dr. Moran synchronized a rubidium clock with the hydrogen maser clock at Haystack before leaving for Russia. In Paris, the rubidium clock was resynchronized with the International Cesium Standard at the Paris Observatory, in case time had been lost during the flight; in Moscow the clock was checked again.

Galactic clouds of water vapor—called masers because they emit enormous amounts of radiation at a single frequency—are an object of extensive research.

The surface brightness, in radio waves, of the masers studied by the Russian-American team is so high that the energy levels of their radiation output would, if translated in temperature, be on the order of 10^{14} degrees F., billions of times hotter than the sun. The astrophysicists' measurements show that the water maser in W3 is slightly smaller than our solar system, while the maser in W49 is about the same size.

The reason scientists think the hydrogen masers may represent stars in the process of being formed is that they have the required heat—they have always been observed in regions of infrared radiation—and the required density. No adequate explanation for the amount of radio energy emitted by the masers has yet been found, but scientists suspect it is closely related to stellar formation. "The material density of these objects is certainly high enough for the formation of solar systems," according to Professor Burke. "They seem to be regions of dense gas—on the order of 10^{12} atoms per cubic centimeter—that have started to condense but have not yet reached the point of becoming a star."—*J.M.*



The A.I.A.A. committee feels a scenario something like this would best use a space shuttle effort. Called a Research and Applications Module system, it involves interchangeable modules that would fit into the shuttle and be removed in space to become part of an orbiting laboratory, or to orbit by themselves. These small building block laboratories could be fitted out for many kinds of research or production purposes. (Photo: A.I.A.A.)

Nuts and Bolts For the Shuttle

Most of the United States space effort for the next decade is concentrated in the space shuttle program—a concept in which a number of space projects can use reusable equipment for transport to and from outer space and for sustenance in it. When this direction became clear, the American Institute for Aeronautics and Astronautics (A.I.A.A.) set up a committee to evaluate N.A.S.A.'s program and to recommend additions or changes: the committee reported to the society's meeting in Washington last January.

The committee, first of all, concluded that a space shuttle system, including both manned and unmanned flight, ought to be built.

It also described what it thinks a full-fledged system ought to look like and operate—something like what is shown in the above drawing. That scenario would require three flying machines: the shuttle itself, a hypersonic, delta-wing craft as big as a DC-9; a set of interchangeable modules for different kinds of experiments to fit into the shuttle's payload bay, some containing only equipment, some also sustaining living experimenters, some that might be placed in an orbiting laboratory, some that might orbit on their own; and an interorbital transfer stage—a tug—to ferry these modules from one orbit to another or to place them in trajectories bound for moon or planet. N.A.S.A. so far is funding only the first—the shuttle itself.

The flights that N.A.S.A. and other agencies want in the 1980s will require the system to put a payload weighing anywhere between a few hundred to some 12,000 kg. into an orbit between 185 and 35,800 km. (geosynchronous orbit) or beyond. The shuttle should last for 10 years at least, requiring major maintenance only every 100 flights. It will take off like a rocket, jettisoning its two solid rocket boosters at 40 km., and its expendable external fuel tank somewhat later (this, unlike the rocket engines, is not recovered and reused), and land back on earth on a runway as a glider.

The shuttle that N.A.S.A. plans will have free for its payload a space 15 by 60 ft. and will carry up to 65,000 lbs. A crew of four can travel for seven days routinely; the craft could handle ten. It can carry scientists in their shirtsleeves. Once it lands, it should be able to return to flight within two weeks—and in one day for an emergency rescue. This shuttle should be operational by March of 1979.

The A.I.A.A. committee reported also on how much of the technology for the system we already have, and what we need. We have much in engine, fuel, life support, and other technologies that can be directly applied to the shuttle, it said. But there are specific requirements we cannot fill—many because the craft must be reusable. For example, the space program has already developed a good system of protection against reentry heat—a refractory surface insulation bonded to an aluminum substructure—but we don't know if it will hold up for many reentries. Carbon, cased in refractory metal carbides, looks promising; other refractory materials might be quartz, mullite, aluminum silicates, and zirconium oxide.

The shuttle's main three engines will be rockets burning liquid hydrogen and liquid oxygen, and delivering 470,000 vacuum lb. of thrust each. Nothing we have now will guarantee the long life and freedom from maintenance that these engines must have, so the system will require a new model, the committee reported. The system will also need smaller engines during its orbit and its descent, as the big ones will serve only to lift it. Engines might also need to be developed for the tug, the orbiting lab (if it is built), and for any modules that orbit by themselves, although the committee said that off-the-shelf equipment might be adaptable. North American Rockwell is already at work on the main engines.

The system's guidance, control, and navigation equipment can be evolved from equipment now on the shelf. The instrumentation for the Apollo shots enabled those ships to land close to their targets, but the shuttle must be landed on a runway without power and its shape makes it more vulnerable to atmospheric buffets. Also, the committee reported, N.A.S.A. will need some experience in retrieving the cast-off booster rockets from the ocean.

All of the research and development—and the use—of the space shuttle program might not have to be done by the United States, the committee concluded. For the committee, like many who believe we must continue to explore space, hopes that other nations will share in the effort: the Soviets, with whom we already have an agreement to meet in space, and the European Launcher Development Organization and the European Space Research Organization have indicated they are interested in this sort of exploration of space. The Soviets are involved in a program of their own; the Europeans have already cooperated in studies for parts of the U.S. space shuttle program.—*J.K.*

Rendezvous with Galactic Destiny

Whatever the chances of finding life as we know it elsewhere in our solar system Bernard M. Oliver, Vice Presi-

dent for Research of Hewlett-Packard Co., has no doubt of its existence in our galaxy. Indeed, he told an enthusiastic seminar audience at M.I.T. this winter, one can postulate the existence of a "galactic culture" far advanced from ours in its understanding of physical and social phenomena. That culture would contain the accumulated experience of generations of life on an unknown number of stars among the 20 million in our galaxy whose age and size suggest that they may in fact support life.

It is Dr. Oliver's prediction that tapping this vast reservoir of knowledge will soon have for the U.S. the same priority once assigned to lunar exploration and now to environmental improvement. Dr. Oliver does not propose sending probes on galactic missions. Any spaceship of which we can conceive is too slow, the distances too great. To accelerate a 1000-ton payload to 0.7 times the speed of light, he said, would require the nuclear energy of reacting 10,000 tons of matter with 10,000 tons of anti-matter—enough to meet the world's electrical requirements for 200,000 years.

So Dr. Oliver proposes only a communications link between Earth and the "galactic culture"; and for the present he is content simply to try to listen for some "galactic network" which may already be in operation.

The technology for this is ready: a $1-billion annual investment in a progressively larger and more sophisticated radio receiver system would result in 20 years in a receiver array sensitive enough to detect an intelligence-carrying radio signal averaging the equivalent in energy of only five photons per second per square mile.

This is the "cyclops" system, a plan for systematic surveillance of the universe for radio signals in a window in the 20-cm. wavelength range. There is an elaborate rationale of technical and poetic reasons for guessing that this group of frequencies would most likely be used for communication by any "galactic culture"; the technical ones have to do with reducing interference from natural solar and galactic noise sources, the poetic ones with relationships to spectral lines of interstellar hydrogen and hydroxides which would be known as well to any other culture as to our own.

How can we be so sure that any other culture would share such concepts with us? If our understanding of astronomy is at all correct, we can be certain that the physical laws governing electromagnetic and optical radiation are in fact universal. So we must expect any other culture as advanced as ours to know and use radio waves and optical systems. Beyond that it's hard to tell, but we have no basis for assuming that the particular set of conditions which led to the development of life on Earth, and then to its slow evolution to the present stage, are unique.

Indeed, since our sun is relatively young compared with many stars in the galaxy, Dr. Oliver thinks almost surely the life we learn about elsewhere will have advanced through far more eons of evolution than our own. Hence his confidence that contact with the "galactic culture" will resolve for us the political, social, and even moral problems which seem increasingly to beset our lives. "A rendezvous with destiny," he calls it, to "enhance the spirit of man."—*J.M.*

MEDICINE

Legal Medicine: On Dr. Magrath's Trail

Erle Stanley Gardner dedicated *The Case Of The Glamorous Ghost* to George Burgess Magrath, MD., who helped to develop the science of legal medicine in the first decades of the century. He writes of the gentleman: "During his lifetime he examined over twenty thousand cases of unexplained deaths, and the present highly efficient science of homicide investigation is in large measure due to the trail blazed by Dr. Magrath. The blaze marks on that trail are Truth, Accuracy, Efficiency and Scientific Integrity. Today many feet follow along that trail. . . ."

Mr. Gardner dedicated many of his Perry Mason books to specialists in legal medicine, for he felt they deserved more attention and credit than they got. That has changed in the two or three decades since; so has the field itself. Tools, the precision and sensitivity of which Dr. Magrath perhaps didn't even dream, are in use these days, as the Midwest Research Institute recently reported to the National Institute of Law Enforcement and Criminal Justice and the Law Enforcement Assistance Administration (L.E.A.A.). *Chemical And Engineering News* summarized the report. (Feb. 5, 1973, p. 13-15.)

A big chunk of a crime lab's work is the analysis of blood and blood stains, and that has become considerably more sophisticated in the last ten years. In 1955, the year *Ghost* was written, blood could be typed for only the ABO antigen-antibody system; to that now are added three more systems that also involve detecting the antagonisms between antigens and antibodies in blood cells. These are called the MN system, the Rh system, and the Gm system. The Rh and Gm systems are complex and involve many different factors. (So far, only the ABO system is used in courts in this country; the Rh one as well is used in England.) Technicians can also discern traces of enzymes in blood and blood stains that vary widely among individuals. Two enzymes in particular, phosphoglucomutase (P.G.M.) and red cell acid phosphatase, are promising: and P.G.M. analyses are already accepted in Norwegian courts. Tests for the phosphatase could well be used here within the year.

All of these systems are independently variable, so the analysis of five of them could specify, if not as individually as the analysis of a fingerprint, at least that a given stain could come from less than one per cent of a population.

Forensic chemists are naturally interested also in traces of elements from guns and bullets. And there are new ways to test for and to analyze them. Neutron activation analysis will pick up traces of barium and antimony in a paraffin lift taken from the hand of a person who has fired a gun, although a background count must also be taken for comparison. By a test for electron spin resonance, it will probably be reasonably easy to tell which manufacturer made the powder in a particular shell. And if a patch of skin or cloth has touched a gun (or other piece of metal) and then been sprayed with 8-hydroxyquinoline, ultraviolet light will show up traces of the metal. Different metals show up in different colors, and the shape of the object is defined. This technique is so sensitive it will reveal where a coin has lain on a piece of paper. And whether it was heads or tails.

A gadget that would detect vapors from explosives before they exploded would be especially nice, and two are in the works. There is a gas chromatograph that is sensitive enough, but it is still too slow. A better prospect is a plasma chromatograph that converts a trace gas into a low-power plasma; the ions formed are sent along an electric field, and tell what they are by the time they take for the journey.

L.E.A.A. has supported some of this research, in response to the crime bill of 1968; it is also supporting ways to get well-equipped crime labs to be more widely placed and used—to put more people on the trail blazed by George Burgess Magrath.—*J.K.*

How R. R. Rowe Found Our Goof

Puzzle Corner:
Allan J. Gottlieb

A week ago Alice and I attended an N.C.A.A. semi-final hockey match. As a devoted pro fan I was surprised at the excitement of a college game. The Cornell fans were impressive but were somewhat overwhelmed by the Wisconsin supporters. As our friend Lou D'Angelo said, "It's tough to compete with the Big Ten in tribal rituals." Cornell scored the first four goals, and each time all their fans shouted "Sieve!" at the goalie. We started to feel sorry for him. But then Wisconsin scored and the place went wild. When the Wisconsin crowd shouted "Sieve!" it sounded like the chorus of a Greek tragedy. I don't know how the goalie could avoid feeling guilty.

My congratulations to Dave and Sue Lapin and everyone else at Wisconsin on the national championship awarded their team and the Gottlieb championship awarded their fans.

Problems

We begin with a bridge problem from Paul Berger:

MAY1 With the following hands, South holds a contract for five diamonds. West's lead is ♠4. Do you want to play offense or defense?

	♠ K, 7 ♥ K, 5, 4, 2 ♦ 5, 4, 2 ♣ 10, 9, 4, 3	
♠ J, 9, 6, 4, 3, 2 ♥ Q, 8, 7 ♦ 3 ♣ K, 6, 2		♠ Q, 10, 8 ♥ A, J, 9, 6, 3 ♦ K, 8 ♣ J, 8, 5
	♠ A, 5 ♥ 10 ♦ A, Q, J, 10, 9, 7, 6 ♣ A, Q, 7	

Here is an interesting contradiction, which Arthur Flerser calls "a demonstration that two equals four:"

MAY2 Given that

$$X^{X^{X^{X^{\cdot^{\cdot}}}}} = 2,$$ find x.

Recall that in multiple exponentiation, the evaluation starts at the top and proceeds downward. Thus the substitution

$$u = X^{X^{X^{X^{\cdot^{\cdot}}}}}$$ yields

$x^u = x^2 = 2$, so that $x = \sqrt{2}$.

Now suppose we try solving the equation

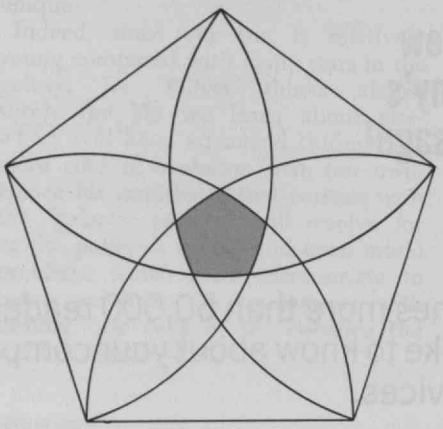
$$X^{X^{X^{X^{\cdot^{\cdot}}}}} = 4.$$

The same reasoning as before leads to the conclusion that $x = \sqrt[4]{4}$.

But the square root of 2 and the fourth root of 4 are precisely the same quantity, both being approximately 1.414. So we are led to the conclusion that 1.414 . . . exponentiated upon itself an infinite number of times, yields both 2 and 4. So 2 = 4. Q.E.D.! What is wrong?

This geometry problem is from Professor Lee Casperson:

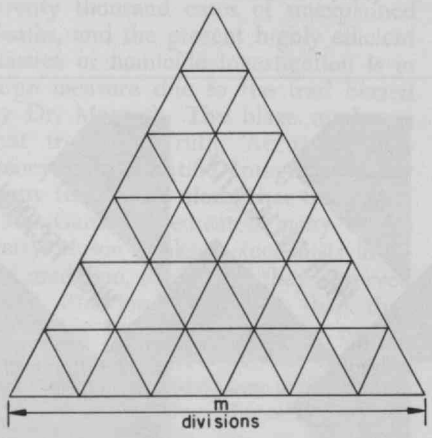
MAY3 Find the exact area of the shaded space in the pentagon with unit sides:



A number theoretic problem from Frank Rubin:

MAY4 Find the quadratic equation with integer coefficients ≤ 10 whose root is the nearest possible approximation to π. (Computer specialists may want to change quadratic to quintic and change 10 to 100.)

In May, 1972, we published a problem about a tile layer and his mosaic surface with a triangle patterned from small equilateral triangles. He claimed that it required 10,000 individual units to form



the large triangle, and that he could retire comfortably if he had as many dollars as there were triangles of all sizes within the triangular pattern. Now the contractor is back again with a new problem, from L. R. Steffens:

MAY5 A tile contractor has laid two floors each composed of 10,000 square pieces—one floor 100 x 100 and the second 80 x 125. What is the total number of squares formed each containing only whole tiles?

Speed Department

Gilbert Shen offers:

SD1 Prove that $(\log_a b)(\log_c d) = (\log_a d)(\log_c b)$.

N. Judell has another proof that 0 = 1:

SD2 Given $\int(1/x)dx \equiv \int(1/x)dx$. Integration by parts gives $\int(1/x)dx = x/x - \int x\, d(1/x)$. Restricting $x \geq 1$ gives $\int(1/x)dx = 1 - \int x(-1/x^2)dx$, because $(1/x) = x^{-1/2}dx$. Then $\int(1/x)dx = 1 + \int(1/x)dx$. Q.E.D. $0 = 1$.

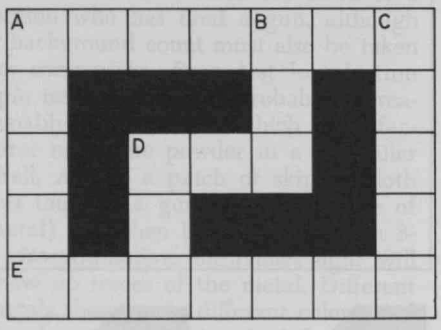
Solutions

JA1 A game of chess has just concluded, leaving (after Black's last move) White's king at his K1 and Black's king at his KR5 (White's KR4). Black, out of whimsy, asks if he can have his last move back. White, never one to give something away for nothing, says all right, if *he* can have his last move back too. Black agrees and takes back his last move. Then White does the same and makes another move, whereupon Black moves and gives checkmate. Problem: find the moves.

Peter Groot finds that the position before the two sets of "last" moves was
White: K at K1, R at R1
Black: K at KN6, Q at KR5.
The original "last" moves were R x Q and K x R. The second pair were 0-0, Q-R7 (mate).

Also solved by Harry Nelson, Norman Neff, and the proposer, Alan La Vergne.

JA2 Each of the letters in the clues (R, S, T, W, X, Y, and Z) stands for a decimal integer which may have many digits. The problem is to find numbers satisfying the equations in the clues and properly filling the blanks.



Across:
A = RI + S
D = X − Y − Z − Z
E = W^W/T

Down:
A = T^S
B = X + X + X + X
C = X + X − Y
D = Y

R. Robinson Rowe found our typographical error and was thus able to solve the problem. His solution is shown below, with the values of the clues and digits in the diagram array.

R = 10
S = 15
T = 2
W = 8
X = 224
Y = 108
Z = 5

A 3	6	2	8	B 8	1	C 5
2	■	■	■	9	■	0
7	■	D 1	0	6	■	0
6	■	0	■	■	■	6
E 8	3	8	8	6	0	8

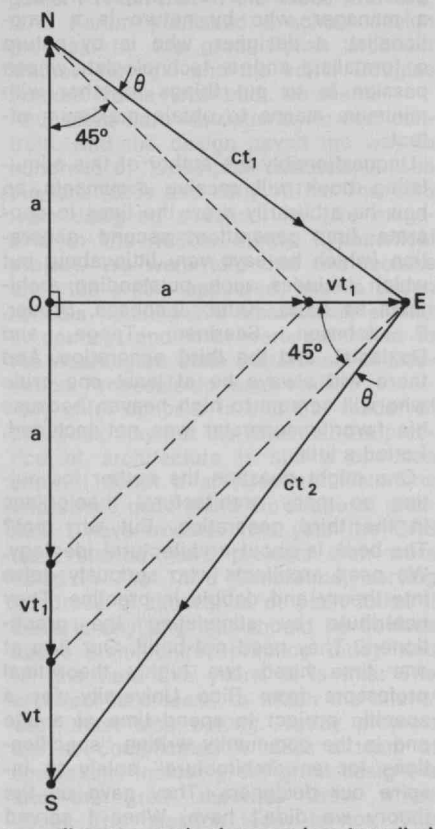
The typographical error was a plus instead of a times sign, so that C = X · X − Y. Mr. Rowe attaches a lengthy "random resume of my speculations" which led him to the typographical error and the solution, but space unfortunately does not permit its publication; readers who wish a copy may obtain one from the Editors at Room E19-430,

M.I.T., Cambridge, Mass., 02139.

Also solved by Peter Groot and the proposer, Harry Nelson. The Editors join in apologizing for the typographical error which so challenged Mr. Rowe—but which may well have discouraged a good many others who found the problem intriguing.

JA3 Four observers N, E, S and W depart the center of an unaccelerated two-dimensional cartesian coordinate system at the same time with equal, constant speeds. N and S travel in the direction of the positive and negative y axes while E and W travel in the direction of the positive and negative x axes, respectively. N directs a ray of light toward E who reflects it with a mirror to S who reflects it to W who reflects it back to N. Each observer measures the angle between the directions of propagation of the received and transmitted rays with a theodolite. They all find the same angle. What is it?

The following is by Harry Zaremba:
In the figure, let

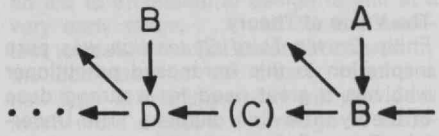


a = distance each observer has travelled before light is emitted from N,
c = velocity of light,
v = common velocity of the observers,
t_1 = time for light to travel from N to E, and
t_2 = time for light to travel from E to S.
From triangle NE0,
$(ct_1)^2 = a^2 + (a + vt_1)^2$, or
$t_1/a = (v \pm \sqrt{2c^2 - v^2})/(c^2 - v^2)$.
From triangle SE0,
$(ct_2)^2 = (a + vt_1)^2 + (a + vt_1 + vt_2)^2$, or
$t_2/(a + vt_1) = (v \pm \sqrt{2c^2 - v^2})/(c^2 - v^2) = t_1/a$.
Also from the figure,
$\tan(45 + \theta) = (a + vt_1)/a = 1 + vt_1/a$; and
$\tan(45 + \phi) = (a + vt_1 + vt_2)/(a + vt_1) = 1 + vt_2/(a + vt_1)$.
Since $t_1/a = t_2/(a + vt_1)$, then
$\tan(45 + \theta) = \tan(45 + \phi)$.
Therefore, angle $(45 + \phi)$ is the complement of triangle NE0, and the angle NES between the received and transmitted rays at E is 90°. The same procedure can be applied at points S, W, and N as illustrated above with similar results. Hence, the angle between received and transmitted light rays at each observer will be 90°. The result is the same irrespective of the magnitude of the observers' common velocity.

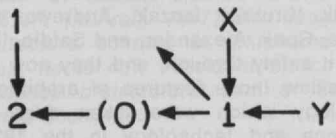
Also solved by J. Bledsoe, J. Fidel-Holtz, Peter Groot, Winslow Hartford, Woodrow C. Johnson, Hans Rasmussen, and R. Robinson Rowe.

JA4 What number ending with the digit 2 is such that when the last digit becomes the first, the resulting number is exactly twice the original?

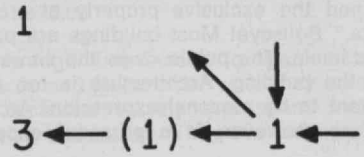
Here is a solution and a free generalization from Kenneth Hules:
Using the following technique we can construct the required number starting from the units place:



where
A = previous sequential digit established
B = units digit of operation (A · multiplier) + previous carry; in this problem the multiplier is 2.
C = carry digit of operation (A · multiplier) + previous carry.
D = units digit of operation (B · multiplier) + C.
From the problem statement we know the first digit (i.e., units) is 2 and the concluding configuration will look like:

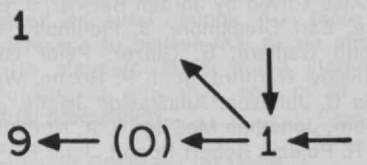


Thus we construct:
1 0 5 2 6 3 1 5 7 8 9 4 7 3 6 8 4 2
2 1 0 5 2 6 3 1 5 7 8 9 4 7 3 6 8 4
to find the required answer:
105263157894736842.
Using this technique we can change the problem statement to any combination of last digit (to become new first digit) and multiplier. No guarantee is given that all combinations possess solutions. For examples:
Last digit of original number = 3, multiplier = 2. The terminal array is



N = 1 0 1 1 2 3 5 9 5 5 0 5 6 1 7 9 7 7 5 2 8 0 8 9 8 8 7 6 4 0 4 4 9 4 3 8 2 0 2 2 4 7 1 9
9N = 9 1 0 1 1 2 3 5 9 5 5 0 5 6 1 7 9 7 7 5 2 8 0 8 9 8 8 7 6 4 0 4 4 9 4 3 8 2 0 2 2 4 7 1

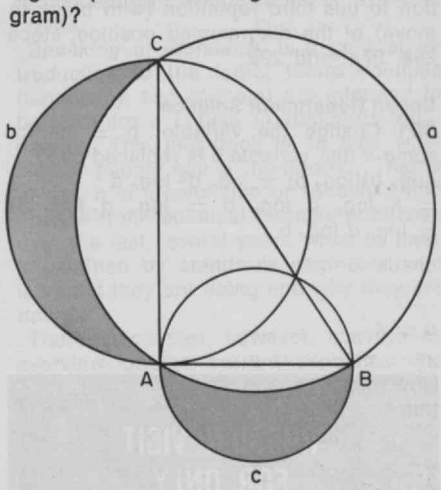
and the construct is
N = 1 5 7 8 9 4 7 3 6 8 4 2 1 0 5 2 6 3
2N = 3 1 5 7 8 9 4 7 3 6 8 4 2 1 0 5 2 6.
Last digit of original number = 9, multiplier = 9. The terminal array is



and the construct is the long number given in the box at the top of this page.
This technique may be used to construct and solve the class of problems wherein the number sought when multiplied by a second number (less than 10) yields a third number whose first digit(s) bear some given relation to the last digit of the number sought (i.e., not necessarily the same digit, as in **JA4**). The trick seems to be to identify the terminal array so you know when to stop.

Also solved by F. F. Assmann, J. Bledsoe, Philip Bobko, C. Brooks, J. Fidelholty, Peter Groot, Winslow Hartford, Greg Jackson, Woodrow Johnson, Thomas Jones, Jonathan McCray, J. D. Miller, Terry Montlick, E. A. Nordstrom, Hans Rasmussen, R. Robinson Rowe, B. Rouben, Sheri Schneider, Jay Schwartz, Robert Shooshan, Larry Wischhoefer, Harry Zaremba, and the proposer, H. W. Hardy.

JA5 Given right triangle ABC with coplanar circles constructed on each of its three sides. The center of each circle is on the midpoint of a side of the triangle, and the length of a radius of a circle is equal to half the length of the side of the triangle. If the area of triangle ABC is 12 ft.^{2}, what is the combined area of the smaller circular regions which are not intersected by the largest circular region (the shaded regions in the diagram)?



The following is from Larry Wischhoefer:
We know by geometry that point A lies on the large circle. By Pythagoras, $AB^2 + AC^2 = BC^2$, and thus the area of two circles
$A_b + A_c = A_a$.

Areas of the respective half-circles are also equal:
$\frac{1}{2}A_b + \frac{1}{2}A_c = \frac{1}{2}A_a$.
We also see that
$\frac{1}{2}A_a = A_{triangle} + A_{shaded} = 12 + A_{shaded}$, and
$\frac{1}{2}A_b + \frac{1}{2}A_c = A_{shaded} + A_{of\ interest}$.
Combining the last two expressions,
$A_{shaded} + A_{of\ interest} = 12 + A_{shaded}$, or
$A_{of\ interest} = 12$.

Also solved by Jordan Backler, J. Bledsoe, Earl Creekmore, J. Fidelholty, Raymond Gaillard, S. Glazer, Peter Groot, Winslow Hartford, John P. Hoche, Woodrow C. Johnson, Anastasios Jsiatis, J. D. Leber, Jonathan McCray, E. A. Nordstrom, E. R. Pejack, Robert Pogoff, John E. Prussing, Hans Rasmussen, Ben Rouben, R. Robinson Rowe, W. H. Stephenson, Roger A. Whitman, Harry Zaremba, anonymous, and the proposer, Mary Lindenberg.

Better Late Than Never

The following names should have appeared last month as having submitted solutions to problems published in December:
DE1 Bill Friedmann
DE2 Harold Rice
DE4 Harry Nelson, Steven Alexander, and Thomas Weiss.
Additional solutions have come from the following readers to the problems indicated:
JY3 Frank Rubin
O/N-1 Frank Rubin, Les Servi
O/N-4 Frank Rubin, Ron Moore
O/N-5 Frank Rubin

Hallock G. Cambell has the following comment on the solution given for M1 as printed in *Technology Review* for October/November, which he says "is quite wrong:"
Puzzler Harry Nelson mistakenly believes that a positional draw in chess requires repetition of three *moves*. No, it requires only a three-time repetition of the same *position,* quite independent of the preceding moves. Game M1 becomes a draw at move 29a if either player calls attention to this third repetition (with black to move) of the diagrammed position, steps 25a, 27a, and 29a.

Speed Department Solution

SD1 Change the variable: $b = d^k$ for some k (the variable b is replaced by k).
$(\log_a b)(\log_c d) = \log_a d^k \log_c d$
$= k \log_a d \log_c d = \log_a d \log_c d^k$
$= \log_a d \log_c b$.

Architecture by Theory, Computer

Book Review:
William W. Caudill

Third Generation: The Changing Meaning of Architecture
by Philip Drew
Praeger Publishers, New York, 1972, 176 pp., $25.00

The Architect and the Computer
by Boyd Auger
Praeger Publishers, New York, 1972, 135 pp., $13.50

Buy both. The value of both these books is their affluence of theory. Architects and their firms die without theory. And some get sick because of an overdose of theory. There must be a mixture of theory and practice. This applies also to schools. There are too many sick firms and too many sick schools that fail to find the balance needed for professional health. Theory needed? It's in the reading.

The Value of Theory

Philip Drew's *Third Generation* was pure inspiration to this hardnosed practitioner who has a great need for a strong dose of theory. The first chapter, "The Uncertain Future," is worth the price of the book. Drew doesn't preach gloom. He challenges. He states, "The first generation," listing Wright, Gropius, Mies van der Rohe, Le Corbusier, Nervi, Neutra, and Fuller, "scavenged science and technology for levers to extricate architecture from the iron grasp of the past and launch it into the new machine age. Their task was to drag architecture into the 20th century. The challenge facing the third generation," he writes, listing the superstars born in the inter-war period, 1918-38, including Rudolph, Van Eyck, Utzon, Roche, Otto, Venturi, Stirling, Chalk, Kirutake, Isozaki, Andrews, Kurokawa, Cook, Alexander, and Safdie, "is to see it safely through, and they now need to review those features of architectural ideology which were taken over from science and technology in the 1920s." That's the gist.

Drew introduces the ideas and resulting products of this selected group of "the third generation" with a high degree of thoroughness. Chapter 2, "Pattern Language" is a beautiful dissertation on architectural form. He points out the problem of modern buildings "expressed in a special form which makes it inaccessible to all but a small band of initiates. Unlike the pattern language of unselfconscious cultures which are shared by all members of the community, the language of modern architecture remained the exclusive property of architects." Bullseye! Most buildings are public domain. The public owns the views, if not the building. Architecture is too important to be personal expression. Architecture, however, is a personal experience—a birthright. In Chapter 3, Drew states that "the third generation reacted against the tyranny of a too-explicit functionalism" and pointed out that Corbu's Ronchamps initiated "a number of important third generation themes" bringing together "rational geometric and intuitive organic ideals in a dynamic synthesis." I take it to mean that the third-generation architects are trying to discover that there exists a symbiosis between functionalism and formalism. If so, I could not agree more.

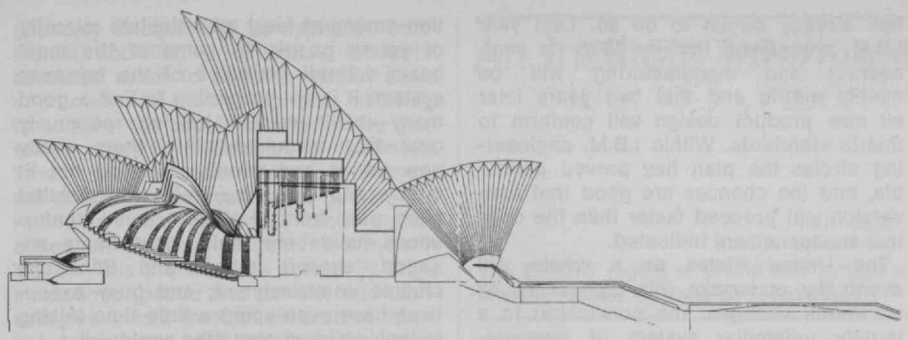
Functionalism in the 1950s became a nasty word. Formalism followed—just as nasty. Since then we have matured professionally. Today I offer no apologies for the formalists—architects obsessed with form—playing on our CRS team. Nor do I offer apologies for the functionalists—architects, including programmers, who are obsessed with function. They are both needed to hold up their end of team action. We feel architecture is too important to be entrusted to one man. When a job comes into CRS we give the leadership to a project troika—a manager, who by nature is a functionalist; a designer, who is by nature a formalist; and a technologist, whose passion is to put things together with minimum means to obtain maximum effect.

Unquestionably the author of this stimulating book will receive arguments on how he arbitrarily drew the lines to separate first generation, second generation (which he says very little about but which includes such outstanding architects as Aalto, Kahn, Jacobsen, Breuer, P. Johnson, Saarinen, Tange, and Doxiadis), and the third generation. And there will always be at least one critic who will scream to high heaven because his favorite superstar was not included. I cried a little.

One might question the author for putting so many architectural theologians in the third generation. But why not? The book is about architectural ideology. We need architects who seriously delve into theory and dabble in practice. They contribute by stimulating the practitioners. They need not build. Our firm at one time hired two highly theoretical professors from Rice University for a specific project to spend time at a site and in the community writing "specifications for an architecture" solely to inspire our designers. They gave us the theory we didn't have. When I served as Director of the School of Architecture at Rice, I deliberately hired theoretical people who could think and write on theory but who had never designed a building. I also balanced the situation by mixing the faculty with top flight architects who were stronger in practice than in theory. Drew's broad choice of architects representing the third generation makes sense. There's a good mix of theologians and practitioners.

The Value of Proposal

Some may wonder why the inclusion of so many proposals for projects, discussed in detail. Not I. Proposals do influence. And they are more pure. And easier to understand than real projects with all the nuances of programmatic



Frank Lloyd Wright, Walter Gropius, and others are members of what Philip Drew calls the "first generation" of modern architects. Their contribution was to "scavenge science and technology for levers to extricate architecture from the iron grasp of the past and launch it into the new machine age." The new task of the "third generation," which Mr. Drew discusses in his book of that title, is "to review those features of architectural ideology which were taken over from science and technology in the 1920s." Jorn Utzon, designer of the Sydney Opera House (above), is seen as the "(third generation's) most compelling and original visionary."

requirements, clients/users, values and goals. I recall that in the 1950s *Architectural Forum* published a school design proposal by the great Polish architect Mathew Nowicki and the editor Douglas Haskell. It was never built. No client.

But there were restrictions. No cost controls. And the design paved the way to hundreds of "open plan" schools built in the late 1960s and early 1970s. The CRS team designed a school for *Life* magazine in the 1950s. Purely hypothetical project. We were told that two months after the article appeared, over a dozen schools (totaling 200 classrooms) similar in concept and form were submitted to the Washington State Department of Education. Proposals do reach reality.

My chief concern is that the reader of this book may get the idea that the practice of architecture is still a one-man show. I doubt if architectural historians and critics understand the scope of practice. I have trouble. This year the CRS team started more projects than were listed in *The Third Generation,* serving hundreds of thousands of plain folks. If there is anything that should be obvious about architectural practice today and for the next five years, it is this: *The architect is a team,* to which the client/user must also belong. Today projects are so complicated it takes a team of specialists, including the great designers and the great theorists Drew writes about. The question today is not, "Are you an architect?" The question is, "What kind of an architect are you?" There are hundreds of kinds, highly specialized in one or two aspects of architectural practice.

Computers Are "Old Hat"

Boyd Auger's *The Architect and the Computer* finds me rather fed up with computers; so consider the reviewer when reading the review.

Computers are "old hat" to the CRS team. They write our specifications, size our beams, figure our heat losses, estimate our building costs at the various stages of design development, simulate the flows of people and things, and tell us what to do and when to do it during construction. The computer as yet does not produce working drawings for us, but it does make graphic analyses which we use in programming. And it has produced floor plans for us to check area take-offs, using a drum plotter as described in this book.

In his last chapter, Auger states, "The development of computer programs as an aid to architectural design is still at a very early stage, . . . and for the architect to realize the full potential offered by the computer he will clearly require a new type of training which will provide a much more detailed knowledge of building design in its widest aspects." Permit me to remind the readers again that there are all kinds of architects, including specialists in computers as well as specialists in creating beautiful form.

Auger's wind-up statement, "To design a large building which serves its purpose well and does not offend those conscious of passing it on the street requires skill, sensitivity, and hard work" could be a fitting ending to Drew's book as well. That's what architectural practice is all about.

William C. Caudill studied architecture at M.I.T. (M.Arch. 1947) and taught in architecture schools in Oklahoma and Texas; he is now President of the distinguished architectural firm of Caudill Rowlett Scott, Inc.

Standards and Our Needs for Them

Book Review:
George A. W. Boehm

Speaking of Standards
Edited by Rowen Glie
Cahners Books, Boston, 1973, xxv + 302 pp., $15.00

It is high time indeed to speak of standards and to consider what they mean to a technical society that spans international boundaries. They are far more significant than is realized by most people —even by engineers trained to use them.

The whole consumerism movement, which says "let me know whether my car is safe" or "tell me what is in the package," is essentially a drive for tighter and more explicit standards. Our international trade, which has just shown a whopping negative balance for the second consecutive year, is hobbled because our standards often do not match those of other industrial nations. And there is good reason to believe that closer attention to standardization would increase manufacturing efficiency and boost industrial productivity.

A Force for Good—or for Harm

The public is only dimly aware of standards and their implications. Some people pay heed to performance standards, such as an underwriter's seal on an extension cord. There is also considerable interest when the Food and Drug Administration or the Federal Trade Commission charges that a product is grossly sub-standard—i.e., fraudulent or harmful. But for the most part people know very little about standards and their importance. They assume that nuts and bolts are made to fit, and they take for granted Standard Time, although their great grandfathers may have balked at the establishment of time zones as an infringement on local autonomy.

Engineers are only a little more enlightened on the subject of standards. A handful of schools offer a special degree in standards engineering. For many engineers in industry, standardization is at best a necessary evil, at worst an enemy of originality. Large companies and government bureaus usually have their own "books" of standards with thousands of entries covering screw threads, testing procedures, composition of alloys, and instructions for wrapping and mailing. From an individual's viewpoint, it is sometimes most convenient to go by the book. But a designer is often tempted to specify non-standard parts in order to get the last iota of performance from whatever he is trying to create.

Speaking of Standards is a general introduction to the topic; future volumes (tentatively, two of them) are intended to be texts for a course in standards engineering. This first book is, in fact, what literary people call a "non-book." That is to say, it is a collection of speeches and articles from technical journals published over the last several years. Most of them are written by standards engineers who tell what they are doing and why they are doing it.

The first chapter, however, conveys an overview of the current problems and opportunities of standards making, even though it was written when the author, J. Herbert Hollomon, was Assistant Secretary of Commerce during the Johnson administration.

Hollomon points out that standards "serve both the highly specialized needs of private industry and the more public demands of people as consumers of products." He also explains that the right kinds of standards can do much good, but the wrong kinds can do

There is a lighter side to Speaking of Standards, *though in this review George A. W. Boehm takes a serious view of the universal importance of the topic. "Through History with Standards" is an American Standards Association feature.*

equally much harm. Bad standards, he says, are written to exclude various products and processes; therefore they deter innovation and competition. Good standards are "inclusive," which is to say that they call only for a certain level of performance and thus challenge a designer or manufacturer to meet them with utmost efficiency, economy, and originality. Hollomon is convinced that a sound standards policy can "actually help reach the goals of the antitrust laws and favor innovation and competition—perhaps better than antitrust lawsuits can."

An Island of Inches and Pounds

Since Holloman and, presumably, most of the other contributors wrote their chapters, standards engineering in the United States has taken on a new dimension. Virtually all the other English-speaking nations have adopted the metric system of measurement, leaving the U.S. a lonely island of inches and pounds in an otherwise metric world.

The U.S. Metric Survey, conducted by the National Bureau of Standards and published in the summer of 1971, shows that being out of step is already beginning to hamper our world trade. The many multinational corporations have to endure the inconvenience and expense of working with two measurement systems and stocking both metric and non-metric parts. Moreover, U.S. exporters are encountering a new kind of trade barrier that is loftier than any ordinary tariff. The Common Market and other groups have begun to certify goods, especially electrical products. In effect, all products that meet the standards of certification are easily traded; others must first be tested. And since the certification standards are written in metric terms, many U.S. exports have to hurdle a high wall.

So severe are the penalties for sticking to a peculiar standard of measurement that several U.S. companies are planning to adopt the metric system. One, I.B.M., has already begun to do so. Last year I.B.M. announced that by 1976 its engineering and manufacturing will be mainly metric and that two years later all new product design will conform to metric standards. Within I.B.M. engineering circles the plan has proved palatable, and the chances are good that conversion will proceed faster than the original announcement indicated.

The United States as a whole will eventually undertake this biggest of all standards changes: the conversion to a largely unfamiliar system of measurement. Last year the Senate passed a metric conversion bill based on the recommendations of the Metric Study. It called for gradual and entirely voluntary conversion over a ten-year period. At the end of that time, the nation would use the metric system predominately, although some segments of society might choose not to conform. In any case, the government would not reward conversion, except for helping to set up coordinating boards, nor would it penalize those who might prefer to stick to inches and pounds.

Reaction was varied. The bill was applauded by people accustomed to the metric system, including most educators and scientists. The House ignored it and let a similar bill die without a vote. *The New Yorker* and *The New York Times,* two adamant defenders of non-conformity, commented angrily that the Senate had passed a non-bill and that rapid and mandatory conversion would be preferable.

At the very least, public interest in metric conversion has awakened a new interest in standardization. As conversion problems become more pressing, standards engineering is likely to become a much livelier and more popular field of engineering.

George A. W. Boehm is a free-lance science writer who helped prepare the report of the U.S. Metric Survey in 1971; he is a member of the Review's *Advisory Board.*

A Change in the Corporate Ethic?

Book Review:
Steven C. Carhart

Student Expectations of Corporate Life: Implications for Management Recruiting by Lewis B. Ward and Anthony G. Athos Boston: Division of Research, Harvard Business School, 1972, xii—211 pp., $7.00

Of all American institutions, few are as totally antithetic to the so-called counterculture as business corporations. Stereotypically at least, business values property over people, order over spontaneity, competition over community, reason over feeling, and growth over the stability of the ecosystem.

In view of the highly publicized opposition among at least an articulate minority of young people to some of the most basic cultural premises of the business system, it is not surprising to find a good many businessmen looking nervously over their shoulders: Are there really new trends and needs which do not fit neatly into plans carefully extrapolated from past trends? White House conferences have been held, consultants engaged, surveys taken, and think-tank studies commissioned; and busy executives have even spent a little time talking to their children about the world.

Professors Lewis B. Ward and Anthony G. Athos set out to analyze in considerable depth a small portion of the total relationship between young people and business. Motivated by a desire to provide better counseling to students at the Harvard Business School, they began their study in 1962 by surveying business students to determine their views and expectations of the corporations for which they were going to work. A similar set of questions was also answered by the recruiters who hired these men, to develop an understanding of how recruiters viewed their own and other companies. The process was repeated in 1970.

The overall objective was to gain some insight into why certain students choose certain companies, why they leave or stay, and what can be done to improve the matching and mutual satisfaction of students and employers.

A Major Threat to Large Enterprises?

Most of the findings will be of greatest interest to placement officers, company recruiters, and others with a professional interest in the placement of business students. But some of the authors' findings concerning the change between 1962 and 1970 in what students consider important in a company which they might want to work for are of very general interest.

Some company characteristics were more important to Harvard Business School graduates as potential employees in 1970 than in 1962: small size, decentralization, emphasis on meeting community needs, and various other characteristics related to close personal relationships in the work situation. Conversely, company characteristics less appealing in 1970 than in 1962 included large size, pressure on reducing costs and increasing profits, close supervision, and emphasis on reports, punctuality, and company loyalty.

The authors conclude that the changes in student preferences are not overwhelming. But they are real, and they indicate the possibility of a major threat to large, mature corporations. The authors ask, "Can it be that the ultimate limitation on the concentration and effectiveness of corporate power and service may not be legal constraint but rather the slow starvation of large corporations for lack of future managerial talent?"

It is interesting that attitudes in a group of such relatively conventional young persons as business students who have accepted jobs with corporations should mirror what I believe to be some of the more basic problems of modern industrial society. Regardless of whether the

economy is described as capitalist, communist, socialist, or otherwise, industrial societies seem to possess certain basic characteristics which lead quite naturally to some of the problems which have generated recent criticisms of business. When industrialization began, the principal problem was scarcity of goods. The remedies were efficiency and growth based on the savings generated by efficiency. This process was served by large institutions (public and private) and technologies which, through division of labor, specialization, and scale, are well adapted to the task of performing (comparatively) routine tasks at a high rate and at low cost.

Now, however, I believe that we may be reaching the point at which our institutions—government, labor unions, corporations, and universities—have become too large for the good of human beings either individually or as a society. The growth and aggrandizement of institutions continues, threatening both the individual and society as a whole, while checks on institutional power which were effective in the past wither in advanced societies.

Narrow Goals and Broad Responsibilities

This is because large institutions (private or public) are typically set up to pursue relatively narrow goals—making automobiles, defending the country, etc. Typically, the larger the institution, the narrower the common denominator which is likely to hold it together. The really difficult problems seem to arise when the scale on which an institution carries out its purpose grows to the point that the consequences of carrying out the basic purpose have major adverse impacts on society at large with which the institution in question is incompetent to deal.

For example, dealing with the consequences of automobile transportation at its present level requires a subtle combination of vehicles, roadways, system planning, and urban design which is beyond the capability of automobile manufacturers. A case could be made that the Vietnam war was to a large extent the consequence of the national security bureaucracy's overzealous effort to deal with every "threat," whether or not it is in the national interest to do so. Another example might be the indiscriminate application of pesticides or other synthesized substances whose full impact on life is not known.

If our institutions are unable to respond effectively to some of the consequences of their activities, the reasons are fairly clear. These problems require broad, holistic, subtle approaches which are likely to be (at least on the surface) opposed to the relatively narrow goals well understood by the individual organizations. Lower-level functionaries are unable to modify their behavior because, regardless of the consequences of institutional activities to those outside the organization, the consequences of failing to uphold policies which further the organization's interests are much greater for the individuals involved. Leaders of large institutions are not in a much stronger position: actions which might

(*Continued on p. 64*)

An Institute Informant

The Editors' digest of recent and current concerns at the Massachusetts Institute of Technology

Safety in the Laboratory

When the U.S. Department of Labor completed one of the first inspections of a university or research institution under the Williams-Steiger Occupational Safety and Health Act of 1970 last winter, M.I.T. was cited for 1,650 instances of 66 different violations and asked to pay a $1,775 fine.

Most of the problems involved elementary housekeeping—compressed gas cylinders not tied down, guards not used on pulleys, hallways and exits congested, fire extinguishers hidden, and so forth. An unresolved question remains: The Williams-Steiger Act requires electrical and mechanical work appropriate for permanent installations; but how can such requirements accommodate to research apparatus, deliberately assembled on a temporary basis so it can be tested and rebuilt as necessary?

Taking the Anxiety Out of Admissions?

Hoping to reduce the heartaches in the process of college admissions, presidents of the eight Ivy League universities and of M.I.T. this winter agreed on a set of common admission procedures. They will try an innovative "early evaluation" plan by which applicants are informed late in the fall or early in the winter whether their admission seems "likely," "possible," or "unlikely." There will also be common deadlines and reply dates for early-decision applicants and for the regular, spring decisions; and the schools will continue to share financial-aid information on admitted candidates.

$6 Million for the Secret to Cancer?

Total commitments of nearly $6 million over a four-year period have been announced for a new Center for Cancer Research at M.I.T. to be directed by Dr. Salvador E. Luria, Sedgwick Professor of Biology who shared the 1969 Nobel Prize in Medicine of Physiology for basic research on viruses.

But Dr. Luria insists that, despite the amount and timing of the funds, they will not be used for "a crash-program approach." He emphasizes the continuing need for basic research and training in cell biology to try to determine exactly what biochemical processes lead to the production of cancer in normal cells. The Center's program will also include research on viruses, known to cause cancer in animals; on immunological characteristics of antigens, whose character is changed when normal cells become cancer cells; and on cell development processes, in which cancer seems to represent a derangement of normal activity.

No clinical studies are planned for at least three to five years.

Of the total funding, over $2.3 million is from the National Cancer Institute for facilities for the Center; $1.8 million will be added by M.I.T. for facilities; some $135,000 from the National Cancer Institute is for operating costs of the Center during the current year, and the Center has also committed itself to provide nearly $1.9 million of operating support for three additional years.

Energy Laboratory

To provide a focus for work on large-scale problems of energy resources and technology, M.I.T. will organize an interdisciplinary Energy Laboratory on the model of its Lincoln and Draper Laboratories; David C. White, Ford Professor of Engineering, will be its Director.

The Laboratory begins with the assignment of tying together some $5 million of energy-related research already in progress on the campus. To this work has now been added the first grant specifically to the Energy Laboratory: $100,000 from the New England Electric System for research "into new equipment, techniques, and methods of supplying electric power."

Albert G. Hill, Vice President for Research at M.I.T., speculates that the new Energy Laboratory will be "on or near" the M.I.T. campus—but it may have field offices and special research activities elsewhere. An annual budget of $10 to $12 million is foreseen "fairly soon." Its long-range goal is to "integrate the economic, environmental, ecological, and engineering aspects with the societal and policy issues involved in maintaining the nation's energy supply, demand, and utilization system," in Professor Hill's words.

The Nixon Budget—in Cambridge

The sharpest effect of proposals in President Nixon's budget for 1973-74 would be on the M.I.T. Graduate School, where its Dean, Irwin W. Sizer, estimates that some $3 million of graduate student support may be lost to M.I.T. next year. The same prospect is in store for others of the most expensive graduate schools, and Dean Sizer says the proposals represent a "disaster to excellence."

Though there are areas of distress—notably in the phasing out of the Cambridge Electron Accelerator and two N.A.S.A.-supported space science projects—the prospects are that federal research funds coming to M.I.T. in 1973-74 will not be very different from those for on-campus laboratories during the current year.

Technology Review's

Classified Section

PUBLICATIONS

TOMORROW'S WORLD . . . a semi-monthly newsletter for those interested in the late 1970's, 1980's and beyond. 24 issues per year; annual subscription rate, $75. For sample copy, write: Hilltop House, Barrett's Hill Rd., R.F.D. 2, Hudson, New Hampshire 03051.

THE YANKEE GUIDE to the New England Countryside. Indispensable for Spring/Summer New England vacationers. On your newsstand now or send $2 to Yankee, Box TR, Dublin, New Hampshire 03444.

WORLD RADIO HANDBOOK. Complete list all shortwave broadcasting stations. Get first-hand news and science reports from London, Moscow, Sydney, Tokyo, etc. When and where to tune. 400 pages. Only $6.95. Gilfer Associates, Park Ridge, NJ 07656.

WANTED

CAMERA CATALOGS before 1950 wanted. Lester Hehn, Port Washington, NY 11050.

RENTALS

U.S. VIRG. ISLS. St. John Nat'l Park luxury cottage, hilltop, fabulous views $100-$150/wk. Spring/Summer 617-255-3376.

SCHOOLS

Looking for a High School for a Teen-ager who seeks a different environment?

WASATCH ACADEMY MAY BE THE ANSWER Located in a beautiful mountain valley, 97-year-old Wasatch Academy has a homelike atmosphere . . . capable, concerned teachers . . . a world-wide student body . . . fine music, art facilities . . . competitive sports . . . skiing, camping, mountaineering . . . moderate fees.

Catalog: Box T, Wasatch Academy, Mt. Pleasant, Utah 84647

SUMMER SCHOOL 6/25-8/3—the arts, creative writing, wilderness exploration. Spanish course with two weeks in Mexico.

FOR SALE

IMMEDIATE DELIVERY

PDP 8 series—HP 2116 C
PDP 15/20—Nova 4000
SEL 810 A—DDP 516
also
Tape Drives, Disks, CR, CP
IBM 735 I/O Selectric
ASR 33, 35, 37 KSR 33, 35, 37

"Sonny" Monosson, '48 Bill Grinker, '56
CALL: 617/261-1100
Send for FREE Price List

American Used Computer Corp.
15 School St., Boston, MA 02108

MINIATURE RR. Amer. 4-4-0 steamer, gas diesel, cars, 7½" track, $4750. J. Johnston, 4 Hillside, Rehoboth, MA

ANNOUNCEMENTS

VENTURERS—Community Development Corp. for Professionals who want to start businesses in formation. Non-geographic definition of Community. C. Arcand, 338 Brandywine, Schenectady, NY 12307.

TECHNOLOGY ASSESSMENT & TRANSFER International Conference on Technology Assessment, The Hague, May 27-June 2: Concepts, planning, techniques, and legal and political aspects of technology assessment; assessment of energy policy, ecology, urban problems, and education. Advanced Study Institute in Technology Transfer, Novotel Paris-Every, June 24-July 6: lectures and discussion of latest methodology and implementation of technology transfer. Further information; Marvin J. Cetron, Forecasting International Ltd., 1500 Wilson Blvd., Arlington, VA 22209. (703) 527-1311.

Classified Ads: $2.80 per line; two-line minimum. (Allow 35 letters & spaces for first line; 40 letters & spaces for each additional line.) **Display Ads**: $25.00 for first column inch; $20.00 for each additional inch. Frequency rates available. **Copy Deadline**: one month prior to publication date. Payment in advance of insertion required for less than three insertions in one year. Send orders to: Classified Section, *Technology Review*, M.I.T., E19-429, Cambridge, Mass. 02139.

(Book Review continued)
be widely interpreted as compromising the interests of the institution for which they are responsible could cost them their positions. These considerations, combined with the fact that there is nothing so diffuse and disorganized as the collective interest, help explain why we increasingly witness the advancement of institutional interests at the expense of society's collective interest.

Unfortunately, the checks which have in the past prevented large public and private institutions from pursuing their interests at the expense of individuals and society are now breaking down. The gradually increasing concentration of economic power with the likelihood of reduced competition has been well documented. Gradually increasing interdependence between various sectors of the economy has required greater government activity to manage change. Increasing interdependence also makes it harder for society to take action against any major economic entity without risking the welfare of much of the rest of the economy as well.

The government is hardly an adequate counterweight to corporate excesses. The scale of contributions to the Nixon campaign by major corporate interests is indicative of the growing consolidation and integration of economic and political power in this country. And within the public sector, the impotence of legislative checks on executive power has now become obvious to all.

If there is a fatal flaw in the concept of industrial society and its benefits of wealth through scale and efficiency, it may well be this: We are increasingly committed to institutions and technologies which are so large and important that we cannot restrict them, that we cannot risk their failure regardless of whether or not it is in the public interest to do so. Are the Penn Central, Lockheed, Litton, nuclear disarmament, symptoms of deeper problems of a society populated by mega institutions pursuing narrow institutional objectives at ever greater levels of size and power, to the detriment of both individuals and society as a whole?

Steven C. Carhart (M.I.T.'70) is now a member of the Energy Policy Project, Washington, D.C.; as an undergraduate and graduate student (S.M.'72), he was active in the student group called E.C.I.S. (Effective Communication through Interpersonal Seminars) whose thrust was to help business and industry better understand the attitudes of young people.

Institute Review

The 1973 Operating Gap May Be the Lowest in Four Years; but the Future Remains Uneasy

The excess of expenses over revenues in M.I.T.'s educational and general operations budget for 1972-73, originally estimated at $3.2 million, may be as low as $2.4 million, Paul E. Gray, '54, Chancellor, told the faculty this spring.

This is the budget—between $70 and $75 million annually—which covers all M.I.T. activities except the direct expenses and offsetting direct revenues for sponsored research. The $2.4 million is the projected difference between expenses and revenues in this budget—an "operating gap," Dr. Gray calls it—which must be made up from unrestricted funds.

If the current prediction is fulfilled, it will be the lowest "operating gap" experienced by the Institute in educational and general operations in four years.

Since 1972-73 unrestricted income and gifts are now estimated to be about $3.7 million, Dr. Gray was in effect telling the faculty that, for the second straight year, M.I.T.'s "operating gap" can be more than met from current income and gifts, without tapping reserves. Indeed, Dr. Gray told the faculty, that "gap" can be met from the income currently expected from patent royalties and from fees in lieu of depreciation for research facilities used for sponsored research.

"All the unrestricted gifts, grants, and bequests received during the current year will be available for purposes other than operations," he declared.

The favorable outcome which Dr. Gray proposed for the current year is the result of persistent efforts to reduce nonessential expenses. Since 1970-71 some $7 million (prior to salary and wage increases) has been pared out of educational and operating budgets. (The actual reductions have amounted to $9.2 million, but these have been offset by just over $2 million of uncontrollable increases—inflationary price changes on necessary goods and services such as energy and telecommunications costs, laboratory supplies, and equipment costs.)

Two other trends were also credited by Dr. Gray for the comparatively favorable report which he could give the faculty for 1972-73:

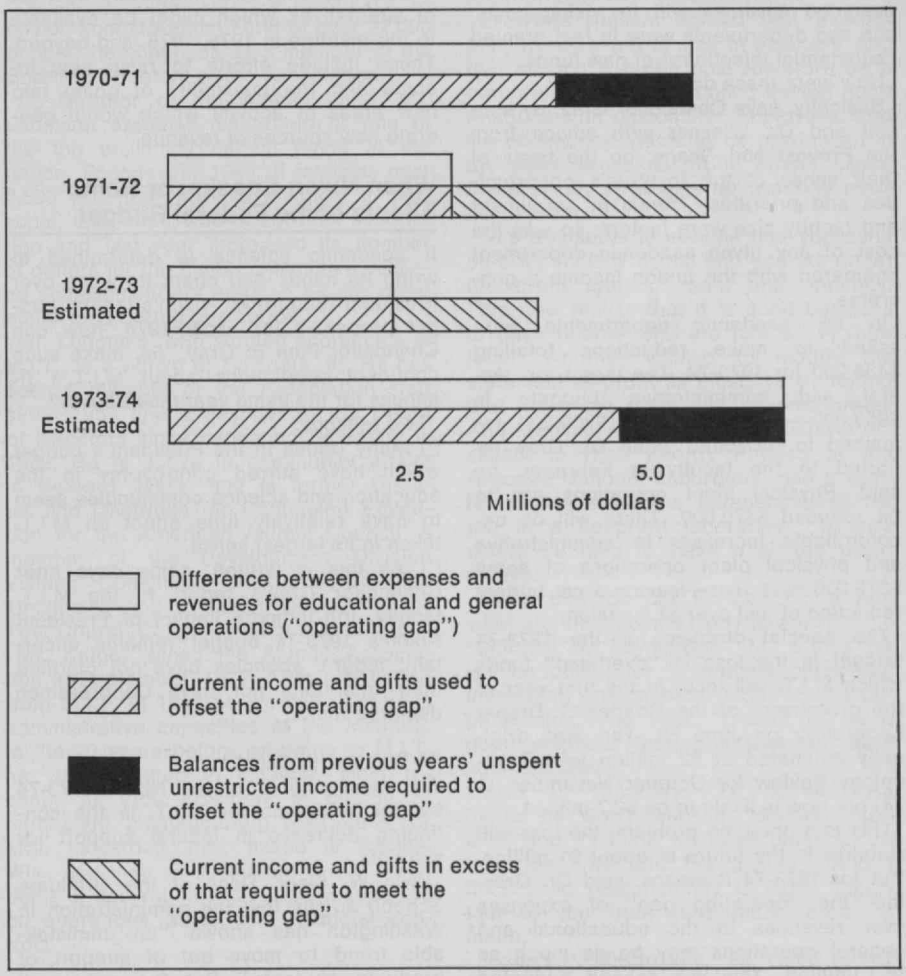
☐ Graduate enrollment, which was expected to decline slightly because of decreasing graduate student support, has remained essentially unchanged.

☐ Departments and offices—both academic and administrative—have demonstrated "very careful stewardship of resources. Everyone, at every operating level, who has responsibility for spending money has been particularly careful not to spend it needlessly," Dr. Gray told the faculty. Indeed, he said, since 1970 "the total of budgeted but unexpended funds has remained in each of these years higher than we dared expect it to be."

What for Next Year?

For 1973-74, M.I.T. has one continuing problem, and one special one.

The continuing problem is that, though both income and expenses are rising



There was once a time when private colleges and universities were able to devote much of their unrestricted income such as gifts to special projects and to building up their endowments. But in two of the four fiscal years shown here, M.I.T. estimates that current income and gifts will in fact be insufficient to meet the "operating gap" between the costs of its educational and general programs and the revenues available to meet them. Under these conditions the Institute will have to call on unrestricted funds given but unspent in previous years.

each year, the growth rates differ so that the two remain unbalanced.

The principal sources of income growth are tuition increases (which everyone seems now to grudgingly accept on an annual basis) and growing income on endowment. But inflation takes its toll, and the costs of simply maintaining existing programs are rising faster than income resulting in a recurring annual $1 million excess of expense growth over income growth.

It is what Dr. Gray calls his "$1 million problem," and no easy solution is in sight.

Last year Dr. Gray told the faculty that he felt the budget cuts then being made for 1972-73 were the last which could be taken incrementally—simply by asking every activity to find the roughly 3 per cent that was necessary to bring expenses to what President Jerome B. Wiesner, Dr. Gray, and the Executive Committee of the Corporation thought would be manageable.

So reductions to control the "$1 million problem" for the 1973-74 budget have been made selectively. Some academic departments were asked to make cuts of as much as 7 per cent; others—six in number—simply to maintain their 1972-73 levels next year in the face of what everyone assumes will be rising costs; and two departments were in fact granted "substantial injections" of new funds.

How were these decisions made?

Basically, says Chancellor Gray, by himself and Dr. Wiesner with advice from the Provost and Deans, on the basis of their sense of the Institute's opportunities and priorities. Trends in enrollment and faculty size were factors; so was the cost of any given academic department compared with the tuition income it generates.

In all, academic departments were asked to make reductions totalling $485,000 for 1973-74. The target for general and administrative budgets is $953,000—of which some $200,000 remained to be found when Dr. Gray reported to the faculty in February, he said. Physical plant operations are to be reduced $470,000. There will be uncontrollable increases in administrative and physical plant operations of some $378,000 next year—leaving a net budget reduction of just over $1.5 million.

The special problem for the 1973-74 budget is the loss in "overhead" funds which M.I.T. will incur in the first year of the divestment of the Charles S. Draper Laboratory on June 30. This was originally estimated at $2 million (*see* Technology Review *for October/November, p. 74)* but now is likely to be $2.7 million.

This is a one-time problem; the loss will stabilize in the future at about $1 million. But for 1973-74 it means, said Dr. Gray, that the "operating gap" of expenses over revenues in the educational and general operations may be as much as $6.1 million. This will exceed budgeted unrestricted income by between $1 and $2.6 million. This amount, reduced by whatever budget changes occur during the year, represents a call on unrestricted fund balances accumulated in prior years.

What of the Long-Range Future?

M.I.T.'s continuing problem is the $1 million annual imbalance between the growth of revenues and of educational and general expenses. It could be neatly solved if the Institute could count on $20 million of new endowment every year, to yield (at 5 per cent) the $1 million in new unrestricted funds. It could also be solved by what Dr. Gray calls "a massive budget cut."

The second route seems unmanageable; the first, while requiring extraordinary effort, is possible.

Dr. Gray takes comfort from the fact that budget reductions achieved so far since 1970 have not resulted in closing down any major M.I.T. activities. "There is very little we were doing three years ago that we're not doing now," he says, "even though there have been significant contractions in the scope of some services."

But he holds out no promise that the same can be said five years hence.

Dr. Gray warned the faculty at the end of his report in February that "if we have to continue budget reductions in the future, cutting will require selective elimination of activities or services."

But he does not accept that as inevitable. Indeed, Dr. Gray told the faculty, "we are looking very intensively at a set of alternatives which might be available to the Institute in 1975, 1976, and beyond. These include efforts to raise new income and the possibility of going into new areas of activity which would generate new sources of revenue."

When Nixon Speaks; or Some Effects of the Federal Budget

If academic science is determined to wring its hands and chant its woes over President Richard M. Nixon's federal budget proposals for fiscal 1974, how can Chancellor Paul E. Gray, '54, make such confident predictions about M.I.T.'s finances for the same year *(see above)*?

Two reasons:

☐ Many issues in the President's budget which have stirred controversy in the education and science communities seem to have relatively little effect on M.I.T. taken in its largest sense.

☐ As this is written, some days after Chancellor Gray's report to the M.I.T. faculty, the ultimate impact of President Nixon's 1973-74 budget remains uncertain; federal agencies have not clarified their intentions nor have Congressmen declared theirs.

"A Disaster to Excellence"

The most critical of the Nixon 1973-74 budget proposals for M.I.T. is the continuing decrease in federal support for students.

Irwin W. Sizer, Dean of the Graduate School, admits that the administration in Washington has shown "an unmistakable trend to move out of support of graduate students." But the movement has suddenly become precipitous.

The unexpected bad news is the phasing out of National Institutes of Health Traineeships, under which 172 students are currently studying in the M.I.T. Graduate School. Next year, Dean Sizer estimates, the number will be down to 115—for there will be no new "starts" at all.

There will also be a reduced number of National Science Foundation Fellows at M.I.T. next year—perhaps 170 instead of this year's 193. The reason has to do less with federal budgets than with the preference which N.S.F. is obligated to give veterans, of whom many will be returning to graduate study in September. Because only a few graduate students were drafted from M.I.T., the Graduate School expects few veterans to bring their N.S.F. Fellowships to Cambridge.

Fellowships of the Atomic Energy Commission, Department of Health, Education and Welfare, and National Aeronautics and Space Administration are being discontinued as expected, and 10 grants now in effect at M.I.T. will not be renewed next year.

In all, these losses represent about $3 million of graduate student support, and there is no obvious place from which it may be replaced, says Dean Sizer. Under these conditions the most expensive graduate schools are the most threatened—a "disaster to excellence," Dean Sizer calls it, citing the rapid growth of graduate enrollments in less expensive, lower quality institutions.

Would-be graduate students unable to obtain federal support may have three alternatives for attending M.I.T.:

☐ They can, of course, attend the Institute at their own expense. As few as two years ago this was essentially unknown; this year perhaps 5 to 10 per cent of M.I.T.'s graduate enrollment is in this category, says Ronald S. Stone, '59, Assistant to the Dean of the Graduate School.

☐ Some of the most outstanding graduate students can be supported by M.I.T.'s Sloan Basic Research Fund—an emergency use of this resource to help maintain the Graduate School's reputation for excellence.

☐ Some would-be graduate students will be able to qualify for support as research assistants. Already M.I.T. has a larger proportion of its graduate students employed in this way than any other U.S. university, and the question of whether still more such jobs can be found hinges at least in part on the ability of M.I.T. faculty to compete for federal research funds.

To provide 150 new research assistantships next year, M.I.T. would need to increase its sponsored research by some $7 million—a prospect which President Jerome B. Wiesner calls "not very likely in view of the general level of funds for research."

Indeed, President Wiesner warns that the Institute must prepare "for what might be a significant drop in graduate student enrollment in most fields."

Do We Need $1 Million to Loan?

What about financial aid for undergraduate students?

The strategy in President Nixon's 1973-74 budget is to shift government-sponsored student aid from loans for needy college and university students to grants limited to the very neediest. It's still too early to know whether this strategy, not politically popular, will be the policy of Congress.

Federally supported scholarships for the neediest students—representing some $150,000 a year at M.I.T.—are likely to continue, perhaps in a different format but little changed in scope, thinks Leonard V. Gallagher, Associate Director of Student Financial Aid.

President Nixon proposes no new funds for the National Direct Student Loan (N.D.S.L.) program in 1973-74, under which M.I.T. students this year receive just under $817,000 of federal money; the total of the program, including repayments and matching Institute funds, amounts to a husky $1.3 million loan fund for 1,370 students. If no new money is available in 1973-74, M.I.T. would have only repayments of previous loans to award next year—$300,000 instead of $1.3 million.

Research: Sharp but Localized Pain

Though there are dislocations and some very specific examples of serious losses, the outlook for federally supported research at M.I.T. under Mr. Nixon's 1973-74 budget is not unfavorable, says Joseph F. O'Connor, Assistant to the Vice President for Research.

The largest single disappointment—though hardly unexpected—is the probable demise of the Cambridge Electron Accelerator, a $12-million, 10-year-old high-energy machine which has most recently been used as a 5-billion-volt colliding-beam generator. Its current operations (jointly between Harvard and M.I.T.) are budgeted at $2 million annually, and the Atomic Energy Commission has warned that only $600,000 will be available in 1973-74—just enough to finish analyzing current experiments and to close down the laboratory.

Professor Karl Strauch of Harvard, Director of the Accelerator, is distressed—but admits that obsolescence is a large factor in A.E.C.'s decision. There is little optimism for a proposal to the National Science Foundation for funding the accelerator as a National Synchrotron Radiation Facility.

A sharper (because less expected) discontinuity in federal funding confronts the Center for Space Research, where N.A.S.A. funding will drop from $5.2 million in 1972-73 to $3.2 million in 1973-74. Two cosmic ray satellite experiments, budgeted for $9 million and planned for launch in 1976-77, have been sharply cut and their schedules stretched from five to seven years; and "there is some risk that the experiments will be scratched completely," says an M.I.T. report to Charles V. Kidd of the Association of American Universities. Subcontracts have been cancelled and some professional people have been laid off. But the biggest losses are more subtle: they are "the proposals for new experiments that will not be generated" because research workers feel "little likelihood that they will be funded," says the M.I.T. report.

Though total funds for the Laboratory for Nuclear Science from the Atomic Energy Commission will increase slightly, there are two areas of concern—in addition to the Cambridge Electron Accelerator. There may not be enough money in the 1973-74 budget to assure start-up of the new Bates Linear Accelerator (*see* Technology Review *for June, 1972, pp. 79-80).* And M.I.T.'s high-energy physics program needs $3.1 million, while only $2.6 million is in the new budget; if additional funds are not found, one or two of ten major experimental efforts will have to be dropped.

But all these losses to certain M.I.T. research programs are likely to be offset by gains in others—notably in the life sciences and operations research. So the volume of on-campus federal research at M.I.T. in 1973-74 may be little different from that in 1972-73.

Alumni Association: A New Vice Presidency and Two Appointments

Frederick G. Lehmann, '51, Secretary of the M.I.T. Alumni Association since 1962, has been named to the new position of Treasurer and Financial Vice President.

He will be succeeded as Secretary by Richard A. Knight, '47, who joined the staff of the Association last fall as Associate Secretary.

In his new position, Mr. Lehmann becomes responsible for the overall financial management of the Alumni Association and becomes Director of M.I.T.'s $3 million annual Alumni Fund of over 22,000 donors; he continues as a member of the Board of Directors of the Association.

As Director of the Alumni Fund, Mr. Lehmann assumes leadership of one of the top university annual funds in the nation. Founded in 1940, it involves over 2,500 volunteer workers annually in personal, telephone, and direct mail solicitation and last year increased its number of donors for the ninth consecutive year—an achievement not equaled by any other major fund during this period.

Mr. Lehmann, who studied economics at M.I.T., is a native of Hinsdale, Ill. He has been a member of the Association staff since 1959 and a member of the Board of Directors since becoming Secretary in 1962. He is active in community affairs in Boxford, Mass. and is former Director and Chairman for Continuing Education for the American Alumni Council, a member of the Development Division Visiting Committee of Carnegie-Mellon University, and a former Deacon of the First Church Congregational in Boxford.

Mr. Knight joined the Alumni Association in September, 1972. After graduation from M.I.T. in 1947 he worked in various administrative capacities at the Institute. In the 20 years before returning to M.I.T. he was engaged in industry, most recently as Vice President in charge of multi-plant manufacturing operations for MSL Industries, Inc., based in Racine, Wis., and then as consultant to the presidents of several medium-sized companies on operations, sales, and financial controls.

Sparks Flew in Chicago

"The problem with M.I.T. is that it's getting as stodgy as Harvard. . . . We used to have meetings like this much more often . . ."

That's how one alumnus summarized the M.I.T. Club of Chicago's rap session between students and alumni late last winter. It was a small group—20 alumni and 10 students—but beer and conversation flowed freely at the Germania Club.

F. G. Lehmann, '51 *R. A. Knight, '47*

Mark H. Baxter, '50, Vice President of the First National Bank of Chicago, struck the first fireworks of the evening by proposing that most industries for which M.I.T. students might work after graduation were like his bank: organized and managed "to make as much money as possible for its owners." That's the only incentive he knows, he said, which assures that a company be operated at an appropriately high efficiency.

Everyone present agreed that a company needs profit to stay in business, and that making a profit must therefore be a corporate goal. Some called having good relations with customers, employees, and the community, goals to be maximized in the same sense as profit; others called these simply strategies for assuring maximum profit.

"It's a mistake to assume that you can't be both socially useful and operate under the profit system," said one alumnus. "We now realize that it is good business to have people who are fulfilled in their jobs." Another wanted to modify the statement of profit as incentive by noting that too much profit can become greed. And Marshall W. Keig, '49, Executive Assistant in High Energy Physics at the Argonne National Laboratory, had a wistful remark from the perspective of his job in a nonprofit laboratory: "It sure would be nice to have a simple profit motive!"

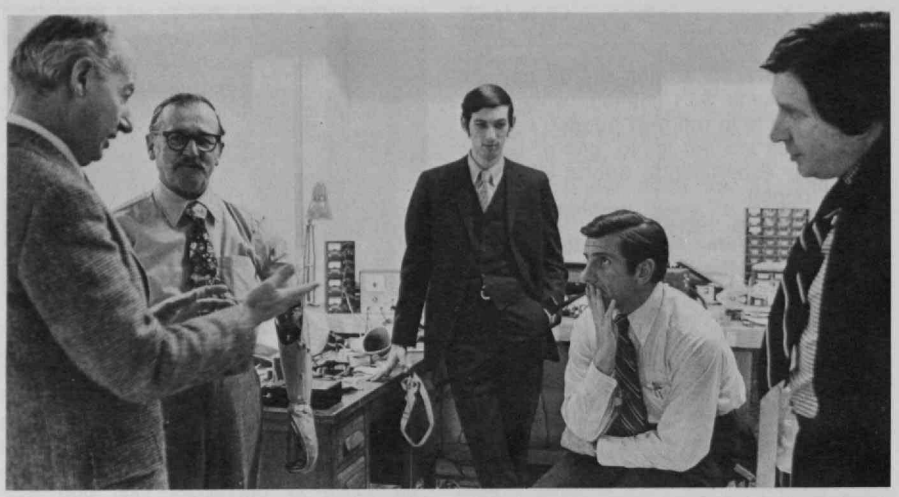
When they go out to look for a job, what are the students likely to want?

Mitchell J. Szymanski, '74, thinks he will be looking for "a creative, enjoyable, interesting environment. I don't want impersonality," he said. "I want to be a good engineer first, and take on management later."

Mark L. Tanquary, '76, agreed. He thinks he won't want a "departmentalized" job. "I think we need personal interaction," he told the alumni. "And I think civic responsibility is more important to me than how much profit is made."

Joseph P. McCluskey, '50, Chief of the Environmental Affairs Department at Commonwealth Edison, feels the same way: "The fun of being in business is dealing with people."

Speaking for A. B. Dick Co., Allan I. Roshkind, '37, said new employees are expected to take perhaps a year to develop into self-sufficient workers, and the



"What About Tomorrow?" took ABC Television viewers into M.I.T.'s Sensory Aids Center on March 16 (top) where Robert W. Mann, '50, Professor of Mechanical Engineering (left) talked with ABC Science Editor Jules Bergman (right center) about such prosthetic devices as the "Boston Arm." On May 14 (10:30 p.m. E.D.S.T.) will come "Facing the Consequences," a show on the effects of technology produced by Jon Wilkman (center, below). Meanwhile, Martin Deutsch, Professor of Physics at M.I.T., waxed enthusiastic about "Searching the Unknown" on April 20: ". . . a series of revealing conversations with . . . believable human beings." (Photos: Sheldon Lowenthal, '74)

company's effort is to choose young people with guts, imagination, and "sparks flying." But he—and most other alumni at the meeting—were troubled because "young people don't seem to want to start at the bottom." Jacques E. Hoffman, '66, went further: his three-man company (Intertech Development Co.) "can't afford M.I.T. graduates," he said.

What About Tomorrow? After Two Shows, Wait and See . . .

Only a modest vote of confidence came from both critics and audience after the first two shows in ABC News' series, "What About Tomorrow?" in which M.I.T. is the collaborator and principal location.

After the first in the series—"On the Side of Man," a review of the impact of computer and communications developments—the *Boston Globe*'s reviewer complained that "the material was too theoretical and remote . . ." He hoped that "the practical applications that will come later will be more interesting and useful."

Howard Thompson, watching it for the *New York Times*, found the computers "feeding back words, seemingly talking like a person, eerily fascinating." But many viewers found the goal of understanding the computer—in contrast to being fascinated by it—still elusive after a 30-min. telecast.

The second program, on urban problems in relation to new technology, fared better at the hands of both reviewers and viewers. The *Globe* called it "meaty, heady stuff . . . that needs more widespread understanding and more practical applications to make a dent."

Some 200 viewers wrote to "Room 100, M.I.T." for further information after the first show—mostly teachers looking for reading lists or seeking prints of the program for classroom use; the second show brought more than 400 such responses. Some comments from viewers:

About "On the Side of Man," the program on computers:

☐ "Our 12-year-old son especially enjoyed it. He asked me how the children were chosen to participate, and I told him they were probably local children. . . . (He) could possibly be rated as a gifted child in math. I would like to correspond with someone on your staff who is interested in children like this."

☐ "You could program a computer to reproduce the masters. Art, technique, available paintings, colors used, etc., and general personality would be programmed. The computer could be a machine or set up a machine capable of using real-artist materials on canvas . . ."

☐ "It sort of made M.I.T. look like an 'awesome place' and far beyond the reach of even the normally intelligent person."

☐ "My wife, my 16-year-old boy, my 13-year-old girl and I all watched . . . found the material difficult to follow, got no message other than that computers can make fun toys and were rather bored by it all."

☐ " . . . that is about all you could expect from a bunch of engineers."

☐ "The older viewers could see bewhiskered freaks, while the younger ones would see the contemporary scientist in action . . ."

☐ "Make sure you show the significant . . . contributions to society. . . . Three different views and sequences of a talking computer just don't fill the bill."

On "Cities—Our Next Frontier":

☐ "It was terrific."

☐ "If possible can you send me any information on the Dilemma of Technology as I am doing a report for school."

☐ "What a great service for you to really study and recommend ways to make our cities fitting for human dwelling."

☐ " . . . please mail me the literature on 'Dial-a-Ride' . . . I am interested in presenting it to the committee at their next meeting concerning the elderly."

☐ "The city is indeed the new frontier and probably the most exciting. It is so close to you, like building your own house!"

☐ " . . . the tie-in with the slick oil company commercials was not attractive to any of us."

☐ "Keep it up—but 'jazz' it up a bit . . . tell your story like you mean it."

☐ "It was dull and poorly organized . . . gave us no real feeling that the ideas could be accomplished."

☐ "My high-school-aged daughter said the only thing she didn't like was that it was too short."

☐ " . . . I was bothered that, except for one point, all of the (work) was based on computers, rationalization, and optimization. This is an excessively narrow form for M.I.T. Forrester said the cities died because the jobs left. What are we doing about that?"

☐ "No one will ever accuse you of using professional actors in place of staff members."

☐ "No reference that I can recall to the political realities of trying to plan in any long-range way for the future of a city."

"Getting Your Guts Clobbered In the Real World . . ."

For civil engineers, too, the good old days are gone, and there's no point in long laments for the simpler life which engineers enjoyed before World War II. Focus, rather, on the real—and very large, and hard—problems of today and

tomorrow, says Peter S. Eagleson, Sc.D.'56, Head of the Department of Civil Engineering.

Once it was easy: the civil engineer's job was to design and build a road, or a dam, or a building; the criteria were good engineering and economic success. Since then, Professor Eagleson told members of the Alumni Advisory Council this winter, there have been two series of changes:

☐ Systems analysis and operations research have brought new sophistication to engineering planning and design, so computers can now be used to test a wider range of alternatives and plan for structural systems far more complex than those which could be imagined in the past. Until the 1960s the profession spent less than 0.1 per cent of its gross on research and development, and the productivity of a fragmented engineering and construction industry was gaining at less than 1 per cent a year. Now that's changing.

☐ But a decade later this ability to build vast new systems turns out to be inadequate, too. Size and complexity simply do not assure that structures meet human needs, particularly when social and environmental constraints are increasingly severe.

What do these changes hold for civil engineering education?

Students must be better equipped than ever, thinks Professor Eagleson. They must learn that their perceptions are no longer adequate; they must have "many alternative ways of reaching multiple objectives through multiple constraints." Hence a broad training—including computer applications and such social issues as environmental and legal action.

The point of it all, he said, is that civil engineers have to leave whatever ivory tower they may once have inhabited. "Our students must learn that they will have their feet stepped on and their guts clobbered in the real world," and this facet of a civil engineering education, Professor Eagleson thinks, was "all too long neglected."

Being Black and Engineer: The Real Question Is Skill

When Robert P. Pinckney, '52, decided to come to M.I.T., his mother told him never to forget who he was—because, being Black, Mr. Pinckney would have to do more to get ahead in the world than any of the white boys he'd be studying with.

Twenty years later, Mr. Pinckney thinks, it's different. "Pay more attention to what you can do than who you are," is his advice to M.I.T.'s Black undergraduates. "America is running out of our technological capital," he told members of the Black Student Union at M.I.T. this winter, and industry needs "people who can produce."

The occasion was a seminar planned by the B.S.U. and M.I.T.'s Career Planning and Placement Office, bringing four Black engineering graduates back to the campus to describe their careers and give advice.

There were two surprising surprises: the alumni were surprised to find so many Black undergraduates at M.I.T., and the students found it hard to imagine that "there really were Black people at M.I.T. before 1969."

Nothing very unusual about the careers which the alumni described. Arthur R. Blackwell, '51, now Associate Director of the Space Systems Defense Office at Aerospace Corp., has been in aeronautics, propulsion, and communications for more than 20 years. Mr. Pinckney considered joining Chrysler Corp. when he graduated; but a professor suggested "there was a small lab over there that you might like," and he's been at the Draper Laboratory as a design engineer ever since.

Ernest M. Cohen, '64, had "a pretty good time" at M.I.T. and took his electrical engineering degree to Foxboro Corp., where he's been ever since. After a few years in aerodynamics and countermeasures work, Herbert L. Hardy, '52, joined a group at A.M.F. which succeeded in building a machine to make hamburgers coupled to a computer and billing system so everything from ordering to paying was automatic. "But the growth rate of drive-ins dropped," so now he's working on new cameras for Polaroid Corp.

If the government stopped making its contractors hire minorities, would companies go back to discrimination against Blacks? There's no doubt that federal intervention was how it all began, thinks Mr. Hardy—and perhaps the movement to hire Blacks would slow down a bit without continued government pressure. But "there's no question about it in my firm," he said; "management means it."

It wasn't always that way. Not until 1958 or so, said Mr. Hardy, "could you walk into a company and be sure they'd talk to you." Now "you can get hired anywhere."

But whether you move up depends on how you do and how much the company believes. It's toughest, thinks Mr. Hardy, at the lower levels; there's much less resistance to Blacks, much more emphasis on job skills and performance, in higher-echelon jobs.

Mr. Pinckney's advice: "I don't think that being Black should be your first concern. I don't mean there won't be discrimination, but it'll be only one of the nonobjective judgments made about you," no more, no less than the others. The real question, he said, is ability to do the job.

Two Honorary Lecturers

First it was Winston Churchill, at the Institute's great Midcentury Convocation in 1949; now it is Cecil H. Green, '23, and Eugene McDermott. What they have in common is appointment as Honorary Lecturers at M.I.T.—the naming of Messrs. Green and McDermott having been announced at a luncheon following the meeting of the M.I.T. Corporation on March 2.

The two new appointments are for Honorary Lectureships in the Department of Earth and Planetary Sciences, in recognition of "the distinguished contributions both men have made to those fields," said Howard W. Johnson, Chairman of the Corporation. They have been

"working together in geophysical exploration and electronics," he explained, "for over 40 years."

Furthermore, said Mr. Johnson, he wanted to reassure President Jerome B. Wiesner: the appointments, though they carried tenure, had no salary attached.

The Independent Activities Period Becomes Permanent

The January Independent Activities Period has cast off its status as a three-year experiment and become part of M.I.T.'s academic year.

The faculty, at its December and February meetings, had weathered a blizzard of graphs and statistics. In February, they voted to adapt the "4-1-4" academic calendar, in which the first term's final examinations precede Christmas, making an honest vacation of the Christmas season, and the second term begins in February. This frees January to be occupied, as it has been for the last three years, by the Independent Activities Period (I.A.P.), in which students explore "mini-courses" and other offerings, some similar to, or extensions of, term-time subjects, some considerably more exotic. With the almost-unanimous (one dissenting vote) approval of that first motion, I.A.P. had won a place in the M.I.T. education. There remained a second motion: the protocol to govern it.

The first motion had required some faculty discussion; the second required considerably more.

Student and Faculty Attitude toward I.A.P.

The former is "overwhelmingly favorable," Professor Kent Hansen (Nuclear Engineering), Chairman of the I.A.P. Policy Committee, told the faculty. And the latter is large and increasing: 85 per cent of the faculty felt I.A.P. was good for them this year, and 72 per cent felt it was good for M.I.T.

The good-personally and good-for-M.I.T. numbers are closer for students than they are for faculty, indicating to the committee, said Professor Hansen, that "what's good for the student, he feels, is good for the Institute."

The percentages of professors, associate professors, assistant professors, and students who agreed that good—personally, and for the Institute, are shown in the chart on the opposite page. The percentages rise monotonically from full professor to student, and all percentages have risen from last year to this.

Participation in I.A.P.

About three-quarters of the student body remain on campus most of the time during January. It is true, though, that students are more likely to remain on campus the more advanced their studies are, more and more likely, from freshman to graduate student. There is, said Professor Hansen, a "monotonically increasing coupling to the Institute." Professor Hansen believes the figure for freshmen is "satisfactory," but it should be better.

The faculty's Committee on Educational Policy was more vocal about its concern. "There is some evidence," that committee wrote in a statement distributed to the faculty at the February meeting, "that a significant number of undergraduates, particularly freshmen, look back on their I.A.P. experience with some regret at having taken too little advantage of the opportunities available. We are aware that regrets of this sort apply in some degree not only to I.A.P. but to the rest of the year and to life in general. We also recognize that some inefficiency and floundering is natural for students as they learn to form their own initiatives in a largely non-directive and non-compulsory situation, and we believe that for many students the long-range educational benefits of this process outweigh its more immediately apparent liabilities. For others though, we suspect that a sustained lack of genuine engagement is educationally undesirable, and that in some cases the failure to make contact is not entirely of the student's choosing. Thus while the C.E.P. wishes not at all to legislate participation in I.A.P., we urge all of the departments, the advisors, and each faculty member individually to help students (especially first-year undergraduates) toward earlier awareness of and more satisfying involvement in I.A.P. activities of all sorts."

Academic Credit for I.A.P.

338 undergraduates received some academic credit (graded "pass") for I.A.P.-work this year—about a tenth of the undergraduate student body, and a similarly small fraction of the total I.A.P. attendance of almost 8,000. "I do not think that perverts the spirit of independence of I.A.P.," Professor Hansen told the faculty. "We think that's a healthy and not an ambiguous sign."

The I.A.P. Policy Committee's proposed protocol recommended that students continue to be allowed to receive academic units (graded "pass") for work conducted during future I.A.P.'s, this academic credit not to exceed six units (most science and engineering subjects are worth twelve), unless the faculty's Committee on Curricula approves a student's petition for more, or a student undertakes intensive study of one subject, in which case he can receive, with approval of the head of the appropriate department, twelve units of pass.

"The limitations on credit are suggested," the I.A.P. Policy Committee wrote in its report to the faculty, "in order to avoid making the I.A.P. appear as 'business as usual.' In order to foster a spirit of independence and freedom from constraint, we believe credit should be kept in a low-profile status. We hope to avoid the I.A.P. becoming a 'credit race' among students, else the very nature of I.A.P. will be destroyed. . . . We feel that letter grades for I.A.P. subjects would tend to create the image of competition and intensity characteristic of the regular semesters."

Professor of Electrical Engineering Richard Adler, however, wanted faculty members to be able to give 12 units and letter grades to students who take intensive I.A.P. versions of subjects assigned 12 units in their more leisurely term-time incarnations. "I do not believe," he said, "that the argument that I.A.P. is a non-intensive period applies to those

students who do not wish to make it so." He added that far from making I.A.P. a credit race, grading of intensive courses would in fact discourage students from attempting to eke out twelve units of pass during I.A.P. rather than risking a poor grade during a term.

Professor Louis Smullin, Head of the Electrical Engineering Department, spoke in support of this, criticizing a notion of an "independent" period in which "everybody must have independence, but independence as defined." Professor Smullin also agreed with Professor Adler that the number of students who would "subject themselves" to intensive courses during I.A.P. would doubtless be "relatively small."

An amendment to allow faculty to grade students who take intensive subjects during I.A.P. was passed by the faculty.

Incompletes in the Fall Term

There was some fear that the changes in the academic calendar, freeing the last week in December and the month of January, would increase the number of "incompletes"—the temporary grade given for substantial but uncompleted course work—given out in a fall term. Under the 4-1-4 calendar, the fall term, while it contained as many "teaching days" as the spring term, is shorter in total length. For the fall term, 1969, incompletes were 3.6 per cent of all grades issued at M.I.T. The following fall, the term before the first I.A.P., they were 8.4 per cent, a year later, down slightly to 7.2 per cent. Last fall, the percentage again fell, to 5.6 per cent. The early high figure and the subsequent drop indicate that "both students and faculty are maturing with the experience, and better understand how to use the shortened semester."

Faculty Responsibilities during I.A.P.

Here is the I.A.P. Policy Committee's proposed wording:

". . . faculty members are expected to be on hand and available to students during January, just as they are during the rest of the academic year . . ." And "each department has the obligation to offer a variety of activities sufficient to meet the needs and desires of those students who wish to study, read, do research, etc. under that department's auspices during I.A.P."

The Committee on Educational Policy had informally studied variations in departments' commitments to I.A.P. At the extremes, said Professor Hartley Rodgers (Mathematics), Chairman of the Faculty and, *ex officio,* the C.E.P., some departments "required the full battle-stations on-duty status of their department members" while in other departments "there was, it would appear, quite a bit of absence from the Institute." The C.E.P. desired that "every department . . . establish for I.A.P. a pattern of operation which makes its faculty accessible to students on the widest and most various possible basis consistent with maintaining *normal* [italics theirs] levels of research and outside professional activity. Second, each department should try to achieve an equitable distribution of academic responsibilities among its faculty during the nine-month period of each academic year, including I.A.P., and if inequities should arise, it should seek to correct them in succeeding years."

Accordingly, the C.E.P. suggested adding the following italicized words to the end of the I.A.P. Policy Committee's sentence: " . . . under that department's auspices, *and to formulate, make known, and carry out policies which promote the fullest possible faculty participation and an equitable distribution of academic responsibilities among its members."*

Professor Richard Cartwright, Chairman of the Department of Philosophy, mounted an attack on some of the wording of this I.A.P. Policy Committee-Committee on Educational Policy hybrid.

First the I.A.P. Policy Committee's wording: "It seems to me," said Professor Cartwright, "that it's somewhat doubtful whether a department has the obligation to meet just any 'desires' that a student might have."

Then there were the words that the C.E.P. had wanted to add: "With respect to 'formulating,' I see that as . . . more paperwork that a department chairman has to carry out. 'Make known'—well, I'm not sure what that means . . . I just don't get the force of that."

And finally, there was Professor Cartwright's disbelief that anyone "really meant" the *fullest possible* faculty participation. He assumed that what must have been intended was faculty participation consistent with normal research and professional activities, which the C.E.P. had said, but not included in their amendment's wording.

There was eventual agreement that the word "desires" would be deleted, especially after Professor Anthony French (Physics) noted that the word "wish" remained in the protocol, and "wish" implied "desire" to his satisfaction. There was also agreement that the words "consistent with normal levels of research and outside professional activity" would be added. That left the problem of "formulating, making known. . . ."

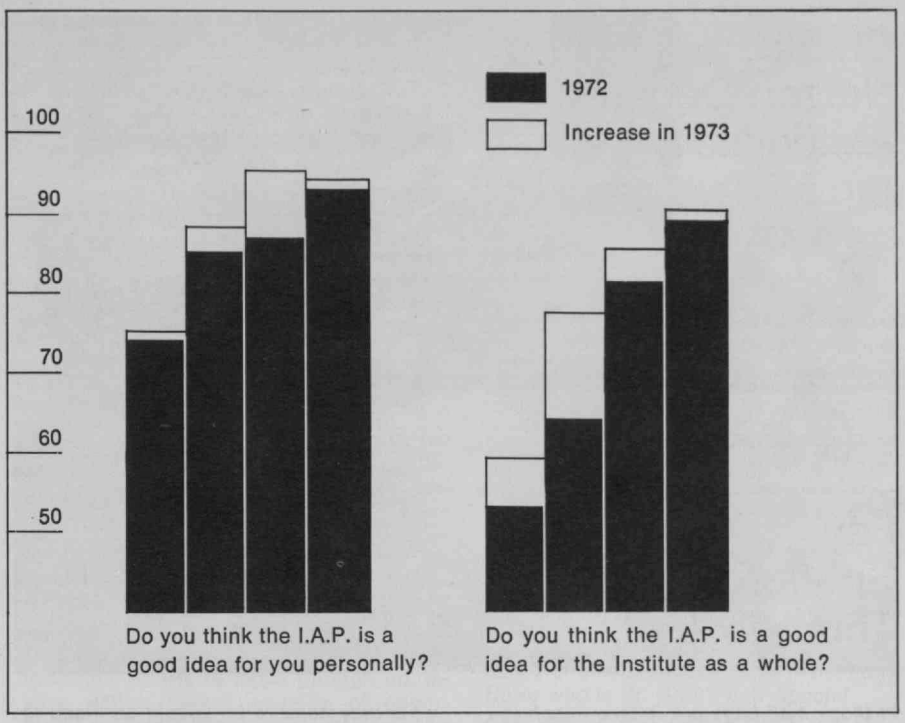
By this time, Professor Cartwright's proposals had taken this form (words to be deleted from the protocol are in square brackets, and words to be added are italicized):

"Each department has the obligation to offer a variety of activities sufficient to meet the needs [and desires] of those students who wish to study, read, do research, etc. under that department's auspices during I.A.P., and to [formulate, make known, and carry out policies which] promote the fullest possible faculty participation, *consistent with maintaining normal levels of research and outside professional activity,* in an equitable distribution of responsibilities among its members.

Professors Rodgers, Hansen, and Cartwright had reached agreement on all of this except the deletion of "formulating, making known . . ." The faculty was therefore called upon to vote on whether or not to remove those words.

The result was a tie, 32 to 32.

The faculty tried again. This time, the deletion of those words carried, 45 to 36. The meeting immediately moved on to a vote on the entire I.A.P. protocol. A multitude were in favor, one voice was opposed.



The results of questionnaires sent to students and faculty after the Independent Activities Periods of last year and this. For each of the two questions, we show four groups' responses; from left to right, the columns represent agreement with the questions by professors, associate professors, assistant professors, and students. All four groups grew more satisfied with the I.A.P.—both for their own sakes and for the Institute's—this year, and satisfaction with I.A.P. tends to increase from full professor to student.

In those mail bags are letters—each individually signed by Peter H. Richardson, '48, Director of Admissions—to 3,765 final applicants to M.I.T.'s Class of 1977. Of those, 174 were early-decision applicants who actually knew last December that they were admitted; another 1,325 were offered admission in these letters, mailed March 27; 290 more were put on the waiting list. To the rest, M.I.T. said a reluctant "no." "Applicant quality was so high and so even that this turned out to be the most agonizing year we've ever had," says Mr. Richardson. "Anyone who thinks the youth of today aren't what they used to be should be made to sit in on a university selection process." A total of 900 places are available in the freshman class next fall; if the 1,499 admissions thus far granted don't yield that number, those on the waiting list will be offered places. A record 15 per cent of those admitted—206—were women and 74 were from minority groups. The woman behind the mail bags—and behind so much of the efficiency of the M.I.T. Admissions Office—is Julia C. McLellan, its Assistant Director for Administration. (Photo: Margo Foote)

Can the Heartaches of College Admissions Be Reduced?

Hoping for an affirmative answer to that question, the Presidents of eight Ivy League colleges and of M.I.T. agreed late last winter on a new joint policy on admissions.

"It is our hope," they said, "that by outlining carefully the procedures under which we operate and by clearly specifying not only what an applicant's obligations are to us but also what our obligations are to him or her, we can help students pursue their college interests free of unnecessary confusion and pressure."

Here are the main points of the joint procedures:

☐ Ivy League colleges should not apply "undue pressure" on any candidate to file an application or to decide to attend. Official information will reach students only through admissions or financial aid offices.

☐ Six Ivy League schools now offering an early decision plan (including M.I.T.'s Early Action) agree to common deadlines for applications and decisions. The two dates are November 1, when applications must be complete, and December 15, when the colleges must report their decisions. With the exception of M.I.T.'s, these early decision admissions are on an "if accepted, will attend" basis. But M.I.T.'s Early Action does not require a decision by the candidate before the May 1 reply date which applies to all other candidates; thus he can choose from all offers of admission.

☐ All the schools will try to help applicants by telling them whether their admission seems "likely," "possible," or "unlikely." Such "early evaluations" will be made starting late in the fall and continuing until February 15 and will be for guidance only, representing no commitment of any kind.

☐ All applicants (except those on whose applications early decisions were made) will be notified by all the Ivy League schools about the middle of April. All will have until May 1 to reply.

☐ All the institutions will continue to follow the common policy that "any financial aid will be awarded solely on the basis of demonstrated need." And to assure fairness, all the Ivy League schools will continue to share financial-aid information on admitted candidates.

Only one item in the new procedures, which go into effect with the 1973-74 year, represents a major change for M.I.T., says Peter H. Richardson, '48, Director of Admissions. That is the "early evaluation" procedure, which is intended to reduce anxiety and give high school seniors a better chance to plan their college careers.

That item was generally the most controversial in the plan. Leonard F. DeFiore, Director of Engineering Admissions at Columbia who was Executive Secretary of the Ivy League presidents' committee, thinks it will be most helpful to those who are rated "unlikely." They'll have earlier warning than they now receive of the likelihood of being turned down—and so can make a more intelligent search for alternatives.

"That Won't Tell Them Anything"

But Mr. DeFiore is worried, he told the *New York Times*, that "an awful lot of the people who are really worried about getting into these places will be rated 'possible.' That won't tell them anything," he said, "and it may even increase their anxiety."

Princeton's Admissions Office responded with some data on its experience with "early evaluation" in recent years. Typically, about half its applicants are rated "possible," said Spencer J. Reynolds, Associate Director of Admissions, and for 1972 admissions 92 per cent of the "likely" candidates were accepted. Robert B. Hullburd, Director of College Placement at Phillips Academy in Andover, was dubious: "A 'likely' from Princeton won't turn out to be the same as one from Harvard," he commented to the *New York Times*.

The Ivy League policy statement emphasizes that each institution will continue to make its own admissions policies. But, the presidents of the schools said, "the transition between secondary school and institutions of higher education has become increasingly complex," and so they sought the new efforts "to simplify the admissions process through more uniform procedures."

Simpler procedures will be welcomed by the colleges, too. For the current academic year, the Ivy League group received almost 64,000 applications for about 10,300 openings.

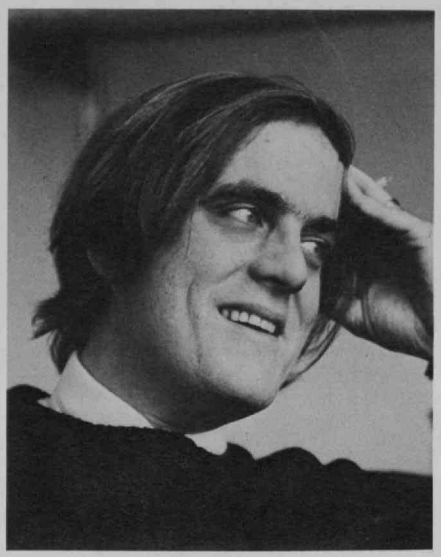
Sorenson on Leaving the Dean's Office: M.I.T. Is One Life, Not Two

"He'll be missed," is what one "Dean's Office regular" told Paul Schindler, '74, Editor of *The Tech*, during the winter when he heard the news: Richard A. Sorenson, formerly Associate Dean for Student Affairs, has left the Dean's Office to become Executive Assistant to the Vice President—Operations.

But it may not be such a long jump after all, for in his new assignment Mr. Sorenson will be involved in current operations and future planning of student facilities and services—as well as for other aspects of the Institute's physical plant.

What about the job you leave? asked Mr. Schindler, interviewing Mr. Sorenson for *The Tech*.

"Working with undergraduates who encounter difficulty; helping them do their lives, resolve things, to grow, to succeed—in their terms, not my terms or M.I.T.'s terms—has been the most important



Students who worked with Richard A. Sorenson, Associate Dean for Student Affairs, as an interface between the Dean's Office and both fraternity and dormitory systems "expressed surprise and dismay" when they heard of Mr. Sorenson's appointment as Executive Assistant to Philip A. Stoddard, '40, Vice President—Operations, according to Paul Schindler, '74, Editor of The Tech. *But Mr. Sorenson reassured them; he'll focus special attention on Institute operations that affect student life, he said. But of contact with students, he also admitted, "I'm going to miss that terribly." (Photo: Margo Foote)*

thing I have done, and clearly the most rewarding." He's also been trying to develop "a philosophical approach that suggests that what we do in housing, activities, athletics, and government promotes a very important educational aim for students . . . which needs to have a relation to the purely academic. The two need to complement each other, not taking priority one over the other.

"You can't just think about a person's life in the dormitory as one life, and his life in the lab, library or classroom as another life, two distinct lives that take place at different times, different hours, for different reasons. They have to mesh," Mr. Sorenson insisted.

And what of the future?

No surprise that Mr. Sorenson expects to continue, through new responsibilities in operations planning, to concentrate on student-related facilities—housing, athletics, activities. "We understand our housing and athletic plant problems pretty well," he told Mr. Schindler. "But we need a planning effort in the activities area, and . . . this is very much an attractive part of the new job."

The problem of space for student activities is increasingly acute, and Mr. Sorenson cited his concern for such questions as "the kinds of spaces demanded, what are the developments and relationships in activities, maybe with things like the Council for the Arts, how we begin to provide more space and better space for activities. How do we implement the existing development plan for athletics? How do we get ahead with the task of finding more housing for students?"

Mr. Sorenson came to the Office of the Dean at M.I.T. in 1967 after two years experience as Assistant Dean of Men at the University of Oregon. He studied history at the University of Oregon (B.S. 1962), then worked for two years in the U.S. National Bank in Portland.

Why a Chancellor's Assistant for Women and Work?

. . . because M.I.T. is committed to a goal, in Chancellor Paul E. Gray's ('54) words, of "a community in which men and women will be represented in every job and student category in proportions determined only by personal choice and merit."

The new post has gone to Mary Potter Rowe, an economist who has most recently been Research Affiliate at the Radcliffe Institute. Her assignment, according to President Jerome B. Wiesner and Chancellor Gray, is to "be involved in the Institute's efforts to move through affirmative action toward equality of opportunity in employment and education for women, and to improve the quality of life for women associated with M.I.T."

Dr. Rowe admits that "it's a peculiar position; it has no appropriate role models," she told *The Tech* at the time of her appointment late in the winter. But she is convinced that "if there is to be any real change in any job or student category there will be changes in all of them." And she is also satisfied of the commitment to the goal shown by President Wiesner and Chancellor Gray, who "have systematically been very determined in terms of policy."

Dr. Rowe studied history at Swarthmore (B.A. 1957) and economics at Columbia (Ph.D. 1971) and has had broad experience combining these disciplines with human relations problems. She has worked on population and labor force data in the U.S. Virgin Islands, industrial development in Nigeria, Black business ownership in Massachusetts, child care systems projects in Boston, and women in New England institutions (her most recent project under a Carnegie Corp. grant to Radcliffe).

Dr. Gray explains his enthusiasm for Dr. Rowe's appointment this way: "She believes that some of the problems confronting women in the search for equality of opportunity in education and employment are not intrinsic to women but arise from the way in which work is structured. This belief, and her deep interest in the problems of discrimination and minority concerns, seemed to us to match exceptionally well the Institute's goals and the aims for which the position was created."

1,650 Violations and a $1,775 Fine for a Reluctant Guinea Pig

There was—and still is—more than meets the eye in the Williams-Steiger Occupational Safety and Health Act of 1970, by far the country's most ambitious effort "to assure so far as possible every working man and woman in the nation safe

Both Chancellor Paul E. Gray, '54, and President Jerome B. Wiesner have been "very determined in terms of policy" in cases of discrimination, says Mary Potter Rowe who is Dr. Gray's new Special Assistant for Women and Work. She is convinced that their intentions are "unequivocal," based on strong "personal conviction;" and that is a principal reason why she decided to accept her new assignment at M.I.T., Dr. Rowe told Sandra Yulke, '74, and Paul Schindler, '74, of The Tech. *(Photo: Margo Foote)*

and healthful working conditions . . ."

Following one of the first inspections of an educational institution under the Act—making the Institute a kind of "guinea pig" among universities—M.I.T. early this year was cited for 1,650 instances of 66 different violations by the U.S. Department of Labor. The Institute was asked to correct its deficiencies and required to pay a fine of $1,775.

The fine has been paid and the deficiencies are being corrected; but that, says Philip A. Stoddard, '40. Vice President—Operations, is hardly more than the beginning of the story.

The Williams-Steiger Act is chiefly a compilation of all appropriate federal standards and "national consensus standards" formed into rules and regulations. As such, says Mr. Stoddard, the Act seems to be hardly more than putting teeth into common sense. But—at least for an educational institution with a considerable commitment to research and development—it is not so simple.

For example, when is research apparatus, assembled on a temporary basis so it can be tested and rebuilt as necessary, to be governed by rules which anticipate only permanent installations? Such questions remain moot, says Mr. Stoddard. But in fairness he hastens to add that M.I.T.'s Department of Labor inspectors exhibited both understanding and flexibility.

Half of M.I.T.'s 1,600 violations were on two counts—unsecured compressed-gas cylinders, and guards not provided for belts and pulleys—mostly on vacuum pumps. Other simple—and common—of-

The Gallery

Winter sports highlights—clockwise: Jarvis D. Middleton, '74, on the rings; Co-Captain Kim R. Hunter, '74, working the puck against Tufts; the fencing team with its fourth straight New England Championship; Coach Wilfred Chassey (rear, left center) watches over the wrestling team's 100th victory (over Boston University) since he began coaching at M.I.T.; and girls' basketball vs. Emerson. Crew in the winter? Yes, M.I.T. oarsmen trained in Melbourne, Fla., in January, found the Johns River a bit too rough. (Photos: Roger N. Goldstein, '74; David A. Green, '75; Margo Foote; Christopher P. Cullen, '76; and Lloyd Behrendt from the Melbourne *(Fla.)* Times.*)*

fenses included fan blades exposed, improperly spliced wires, too many extension cords, obstructed passages and exits, fire extinguishers hidden or improperly mounted, and storage of excessive quantities of flammable liquids.

Improved housekeeping and common sense will solve most of these problems, and indeed by the end of January, just a month after the citations had been listed, M.I.T. reported to the Department of Labor that 60 per cent of the violations had been corrected. The cost may have been as much as $30,000, says Mr. Stoddard.

Some problems are more difficult. At least four of M.I.T.'s buildings are wired with electrical systems which provide substandard grounding for appliances and equipment; modifications will cost $30,000 to $40,000, according to Physical Plant Department estimates. New guard rails on stairways and openings to meet federal standards may also be a problem.

To assure safe practices in the future, each M.I.T. department and laboratory has been asked to designate a safety coordinator; and the Institute's Safety Office has added two engineers to work with these coordinators on continuing safety inspections and education . . . the latter because, says Mr. Stoddard, M.I.T.'s success "ultimately depends on that person out in the laboratory."

A Special Traffic Alert From the Alumni Office

To avoid traffic jams, park your car on the West Campus and leave it there. Everyone expects a record outpouring of students, parents, and alumni for the traditional year-end festivities from June 1 to 4.

Three reasons for the predictions of broken records:

☐ M.I.T. will award more degrees on June 1 than on any previous Commencement Day.

☐ A special symposium—"Focus on the Future," celebrating the 100th anniversary of the graduation of M.I.T.'s first woman student—will bring hundreds of visitors to the campus on June 2 and 3.

☐ The Class of 1948, whose activities will be centered in Burton and MacGregor Houses, is planning for the largest 25th reunion crowd in M.I.T. history.

☐ With many large reunions preceding it, the Alumni Days celebration on June 3 and 4 may well set registration records.

A "mystery speaker" remains to be announced for Alumni Days. Already on the schedule, however, are the concert by Arthur Fiedler and members of the Boston Pops Orchestra on June 3 and the traditional all-day program on June 4. Confirmed speakers include J. Herbert Hollomon, '40, Director of the Center for Policy Alternatives; Salvador E. Luria, Director of the new Center for Cancer Research; Margaret L. A. MacVicar, '64, Director of the Undergraduate Research Opportunities Program; and Jerome B. Wiesner, President.

Focus on the Future

A distinguished roster is being brought together by a committee of the Association of M.I.T. Alumnae to celebrate the centennial of Ellen Swallow Richards' chemistry degree. Speakers already listed to forecast changes in technology and its impact during the second century of women at M.I.T. include Admiral Elmo R. Zumwalt, Jr., Chief of Naval Operations; Katharine Graham, Publisher of the *Washington Post*; Helvi Sipila, Assistant Secretary-General (Social and Humanitarian Affairs) of the United Nations; and Mary P. Rowe, M.I.T.'s new Special Assistant for Women and Work.

The Class of 1948's reunion turn-out is expected to be so big that the traditional on-campus reunion of the 50-year Class of 1923 has been moved to the Marriott Motor Hotel in Newton; the other large reunion—that of the 40-year Class of 1933—will be at the Chatham Bars Inn. The Class of 1948 has the ambitious project of a $500,000 25-year gift, large enough to fund the Class of 1948 Visiting Professorship. Their results—and other reunion gifts—will be announced at the Alumni Day luncheon on June 4.

The 50-year class will arrive early—in order to be honored at the Commencement Exercises on Friday, June 1. Commencement activities will begin on the preceding day with the traditional Commissioning Exercises for students completing R.O.T.C. programs.

The Esther and Harold Edgerton Fund: Students and Teachers Together

A $900,000 fund has been designated from within M.I.T.'s resources to help younger faculty and students work together on new research activities in the Department of Electrical Engineering, and it has been named in honor of Esther and Harold E. Edgerton, Sc.D.'31.

The faculty beneficiaries—typically assistant professors in the department—will be designated as Edgerton Professors and their students as Edgerton Fellows. The point is to perpetuate the kind of relationship between teacher and students that Professor Edgerton has achieved in his stroboscopic light laboratory for over 40 years—and that he and Mrs. Edgerton have achieved in their home over the same period of time. Though he officially retired to become Emeritus Institute Professor in 1968, Dr. Edgerton still maintains his laboratory and a full daily schedule at M.I.T., and he and Mrs. Edgerton are familiar figures at musical events and many other Institute affairs.

In his tribute while reporting on the Esther and Harold E. Edgerton Fund to members of the Corporation at luncheon on March 2, Howard W. Johnson, Chairman of the Corporation, said, "We know and love Doc and his wife as friends to the young—particularly those who may be fearful or lonely or homesick or just perplexed about learning and life."

A more formal expression by Mr. Johnson and President Jerome B. Wiesner was contained in the announcement of the Fund: "There is no more fitting way for us to honor this man and this woman for the devotion, affection, and warm friendship they have given freely to young people at this university over a period of nearly half a century."

Though he did not invent the strobo-

scope (high-speed electronic flash), Dr. Edgerton was the first to capitalize upon it as a tool in engineering and in photography. To dramatize its capabilities he began using stroboscopic light for high-speed photography, and to exploit its technical advantages he organized with two graduate students the firm of Edgerton, Germeshausen and Grier, now E G & G, Inc.

More recently Professor Edgerton has extended his interests into oceanography, to which he has contributed many advancements based on strobe lighting and sonar.

A Minority Graduate Fellowship

The memory of the late Marron William Fort ('26), the first Black American to receive a doctorate from M.I.T., has been honored by a new graduate fellowship at the Institute, the first award of which will be made at the end of the current academic year.

The Fort Fellowship will provide full tuition and living expenses for one academic year for an outstanding M.I.T. senior, member of a minority group, who will pursue full-time graduate study at the Institute. Clarence G. Williams, Assistant Dean of the M.I.T. Graduate School, hopes the new award will encourage minority students to consider graduate study at the Institute—and to work as undergraduates toward that goal.

Dr. Fort held three degrees from M.I.T.—in electrochemical engineering (S.B. 1926, S.M. 1927) and chemistry (Ph.D. 1933). He spent 20 years with A. and J. G. Caldwell, Inc., of Newburyport, Mass., and in 1954 joined the U.S. Department of Commerce, and later State, for which he served in Tel Aviv, Ankara, and Pakistan as well as Washington until his death in 1961.

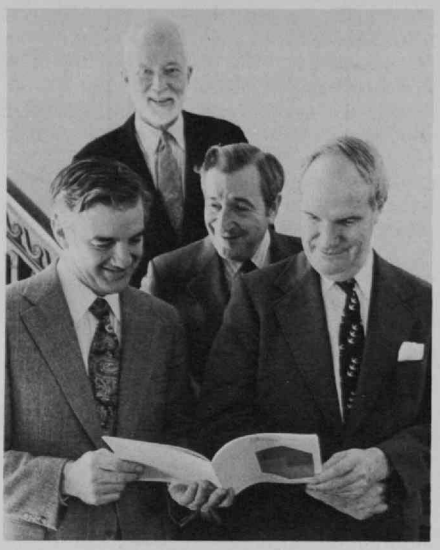
$450,000 for "Highest Intellectual Innovation and Creativity"

Those are the total fund and goal specified by the Henry Luce Foundation, Inc., in making two identical grants to M.I.T. and Mount Holyoke College.

Two $225,000 grants will be used for five-year support of two professorships—at Mount Holyoke in cosmology, at M.I.T. in environment and public policy. The grants can be renewed in five years for an additional five-year term, but they are not—in contrast to the tradition of professorships—to serve as endowment.

Henry Luce III, President of the Foundation, thinks such wasting grants represent "the kind of leverage that a private foundation, even one with relatively limited resources, can exercise to stimulate the highest levels of intellectual innovation and creativity in the nation's colleges and universities at a time of severe financial strain."

The Luce Professor of Environment and Public Policy at M.I.T. will focus on "the policy implications arising from the extraordinary impact of technological advances on natural systems." The Foundation says it is intended "to bridge the gap between two traditionally separate academic areas": science and engineering on the one hand, and the social sciences on the other.



The smiles make it clear that the news was good: Becton, Dickinson and Co. were giving M.I.T. and Harvard a six-year, $1 million grant to support younger professors in the two schools' joint program in health sciences and technology. In the picture (left to right) President Derek C. Bok of Harvard; Henry P. Becton, Vice Chairman of the Company's Board; Jerome B. Wiesner, President of M.I.T.; and Fairleigh S. Dickinson, Jr., Chief Executive Officer of the Company. It was the first major industrial grant received by the Harvard-M.I.T. Health Sciences Program.

Becton, Dickinson? They Make Hospital Hardware . . . and $1 Million Gifts

Seven senior officers of Becton, Dickinson and Co. walked into the President's House at M.I.T. on January 26 for lunch; among those there to greet them were President Jerome B. Wiesner of M.I.T., President Derek C. Bok of Harvard, Dr. Robert H. Ebert, Dean of the Harvard Medical School, and Dr. Irving M. London, Director of the Harvard-M.I.T. Health Sciences Program.

Fairleigh S. Dickinson, Jr., Chief Executive Officer and Chairman of the Board of Becton, Dickinson had brought with him a check for the first installment of a $1 million gift to the two schools; when they left after lunch, Presidents Wiesner and Bok each had his share of the gift, and Dr. London had a new fund with which to support promising younger faculty members interested in how biomedical engineers can use their skills to fill health needs.

(Or, if he prefers, Dr. London—with his colleagues' permission—can use the funds for a single, more prestigious appointment for a distinguished faculty member who might hold an appointment at both Harvard and M.I.T., as does Dr. London himself.)

Payments from Becton, Dickinson and Co. (it is a diversified, international manufacturer of medical, surgical, laboratory, scientific and industrial products for physicians, hospitals, and laboratories) to Harvard and M.I.T. will continue for six

years until the $1 million total has been provided.

In remarks at the luncheon, President Bok emphasized the value of the gift in terms of its attraction for "outstanding scholars," and President Wiesner spoke of the joint program's interest in "the devices and techniques that make possible better prevention and treatment of disability and disease." It will be another example, he said, of M.I.T.'s "commitment and accomplishment in goal-oriented research and development."

J. L. Schwartz

M. L. A. MacVicar

C. E. Barringer

V. Kistiakowsky

An Engineering Educator? But He's an Educator, not an Engineer

. . . which is exactly the idea, according to Alfred H. Keil, Dean of the School of Engineering, who has just named Judah L. Schwartz of M.I.T.'s Education Research Center to be Professor of Engineering Science and Education.

Dr. Schwartz was educated as a physicist at New York University (Ph.D. 1963). His recent effort at M.I.T. has been to make the physics, mathematics, and chemistry required of M.I.T. freshmen part of a framework of broader topics through which their importance becomes clear. The goal, says Dr. Schwartz, is to let students learn more and, equally important, gain much earlier a coherent perspective on what they learn and why.

Now Dr. Schwartz—whose recent M.I.T. work has been in connection with the experimental Unified Science Study Program and a new Freshman Project Year option—will attempt the same kind of goal for engineering students, through what Dean Keil calls "his broad perspective on the role of engineering in the framework of science and technology and its relation to the use of technology in the context of society."

Dean Keil hopes Dr. Schwartz will help the School "bring about a greater coherence between engineering, scientific, societal, and humanistic elements" of its educational programs. He will also provide the engineering departments with professional advice on the development of curricula and teaching methods.

And he will work with the Center for Advanced Engineering Study to apply innovations in undergraduate education to programs in education for postcollege working professionals.

Dr. Schwartz has lectured in physics at the Israel Institute of Technology, and from 1963 to 1966 was at the Lawrence Radiation Laboratory of the University of California. It was here that his interest in innovative physics education led to a series of computer movies showing the physical events and principles involved in the collision of quantum wave packets with a barrier or potential wall. At M.I.T. since 1966, Dr. Schwartz has been a Senior Research Scientist in the Department of Physics since 1968.

A Career Development Prize for the Founder of U.R.O.P.

Margaret L. A. MacVicar, '64, Assistant Professor of Physics and chief author of the extraordinarily successful Undergraduate Research Opportunities Program (U.R.O.P.) (*see* Technology Review *for February, pp. 78-83*), is the first recipient of the Class of 1922 Career Development Award.

Accordingly, in 1973-74 she will have at her disposal a substantial grant to support and advance her professional interests and teaching activities.

The award was the concept of the Class of 1922 and became the principal project for its 50-year fund presented to the Institute last June. When he gave the gift on Alumni Day, Parke D. Appel, President of the Class, said he hoped it would "provide resources to sharpen and supplement the capability of deserving members of the faculty in the development of excellence in teaching."

Paul E. Gray, '54, Chancellor, congratulated Dr. MacVicar for "a spirit of renewal and vitality that is critically important to the Institute . . ." Walter A. Rosenblith, Provost, was equally complimentary: "She has demonstrated extraordinary capability, enthusiasm, and judgment. Her work has had, and will continue to have, a major effect on this entire academic community."

Dr. MacVicar studied physics and metallurgy and materials science at M.I.T. and held a fellowship at the Cavendish Laboratory at Cambridge University, England, in 1968-69. At M.I.T. since then, she has given major attention to such educational innovations as U.R.O.P.—but at the same time has maintained research interests in materials, high-vacuum technology, and electron beam techniques.

Two Administrators, Two Faculty, and a Distinguished Visitor . . .

Five new appointments by the Schools of Engineering, Architecture, and Science:

☐ **Charles E. Barringer**, Administrative Officer of the Department of Mechanical Engineering since 1969, is now Assistant Dean of the School of Engineering; his new responsibilities will be in areas of resource management and planning.

Mr. Barringer graduated from Principia College in 1959 and served at Lincoln Laboratory and the Arecibo Ionospheric Observatory in Puerto Rico before coming to M.I.T. in 1965 for administrative work in the then-new Center for Materials Science and Engineering. The fund allocation and salary analysis systems he developed there are now widely used in the Institute.

☐ **Carl A. Gregor**, formerly Mr. Barringer's assistant in the Department of Mechanical Engineering, has been named the Department's Administrative Officer.

A graduate of Bentley College, Mr. Gregor came to M.I.T. in 1959 for administrative work in the Research Laboratory of Electronics, later serving in various capacities in the Division of Sponsored Research.

☐ **Vera Kistiakowsky**, a distinguished high-energy physicist who has been associated with the Laboratory for Nuclear Science since 1963 and with the Department of Physics as Senior Research Scientist since 1969, has been named Professor of Physics.

Dr. Kistiakowsky, who is also widely known as a champion of the cause of women in science, is engaged in bubble chamber experiments carried out at Argonne National Laboratory and the Stanford Linear Accelerator Center; and she will soon use a new bubble chamber at the National Accelerator Laboratory, Batavia, Ill.

Dr. Kistiakowsky studied at Mt. Holyoke (A.B. 1948) and the University of California (1952) and has taught at Columbia and Brandeis Universities; she became Adjunct Professor at the latter in 1962. In 1965 she visited the Physical Institute at Erevan, U.S.S.R., under auspices of the A.E.C.'s Scientific Exchange Program, and in 1971 she chaired the American Physical Society's Committee on Women in Physics.

☐ **Lewis Mumford**, the distinguished author and critic in the field of planning and architecture, has been at M.I.T. as Visiting Institute Lecturer since April 1. His assignments are to meet informally with faculty and students throughout the Institute, discussing social perspectives on industrial development, technology, and the environment; and to present seminars sponsored jointly by the Department of Urban Studies and Planning and the Technology and Culture series.

Mr. Mumford is well known as the author of some 30 books and many magazine articles; he has had a number of academic appointments, including a Visiting Professorship at M.I.T. from 1957 to 1960.

☐ **J. Clifton Samuels**, Chairman of the Electrical Engineering Department at Howard University, has been named Visiting Professor of Electrical Engineering for the current academic year.

At M.I.T., Dr. Samuels is working on wave scattering and stochastic systems, and he is also involved in the development of graduate studies for minority students. The latter has been the focus of his recent efforts at Howard University.

Dr. Samuels' degrees are from the

Polytechnic Institute of Brooklyn (B.S. in electrical engineering, 1948), New York University (M.S. in applied mathematics and physics, 1950), and Purdue (Ph.D. in engineering science, 1957).

Donald G. Marquis, 1908-1973

Donald G. Marquis, who was last fall named the first David Sarnoff Professor of Management of Technology in the Sloan School of Management, died suddenly on February 17 following a heart attack. He was 64.

Professor Marquis was stricken in his office at M.I.T. on February 16 and was taken immediately to Massachusetts General Hospital, where he died the following day.

In a joint statement, Howard W. Johnson, former Dean of the Sloan School, and William F. Pounds, its present Dean, wrote that Professor Marquis' death "brings sadness to all of us at M.I.T. and to his students and colleagues in the social sciences the world over.

"He was a great psychologist, an imaginative and creative social scientist, and above all a great and compassionate human being," they said. "His respect for rigorous scholarship and his affection for individual students and colleagues are reflected in all those who have been privileged to work with him."

Professor Marquis was internationally known for research in industrial and organizational psychology, and he led a group in the Sloan School concerned with the management of research and development work. He had been at M.I.T. since 1959, having come to the Sloan School to develop the new program in technological management.

Professor Marquis, born in Michigan, studied at Stanford and Yale Universities and taught at Yale (where he was Chairman of the Psychology Department from 1942 to 1945) before going to the University of Michigan where he was Head of the Psychology Department until 1957. He spent one year in England as Rockefeller Foundation Fellow at National Hospital, London, and at the Laboratory of Psychology at Oxford; from 1957 to 1959 he was with the Social Science Research Council, and in 1966-67 he was Visiting Professor at the London Graduate School of Business.

Widely known as a consultant and author, Professor Marquis was President of the American Board of Examiners in Professional Psychology from 1953 to 1957.

Memorial gifts may be made to a fund to support an annual prize for doctoral students which will be awarded in Professor Marquis' name at the Sloan School.

Edwin R. Gilliland, 1910-1973

Edwin R. Gilliland, Sc.D.'33, a distinguished chemical engineer who was Institute Professor and Warren K. Lewis Professor of Chemical Engineering, died suddenly on March 10. He was 63.

Raymond F. Baddour, Sc.D.'51, Head of the Department, described Dr. Gilliland as "one of our most active and productive faculty," and in his eulogy, the Reverend John R. Chapman of Payson Park Congregational Church, Belmont, said "His personal sharing of insight with his students; the record of his stewardship in teaching, in research, in administration, in science, in government, in the times of our nation's crisis, in invention, and in engineering is a record that would embrace many lifetimes of other men of exceptional talent."

All of the gasoline made in the U.S. and much of that made overseas today is produced using a catalytic cracking technique in the development of which Professor Gilliland made signal contributions. He also developed a butadiene separation process which led to the first significant commercial production of synthetic rubber, and he was considered an authority on processes for demineralizing salt water.

Professor Gilliland first came to M.I.T. in 1931 from Pennsylvania State University, where he received the M.S. degree. He became a member of the faculty in 1936 and Professor of Chemical Engineering in 1944. Thereafter he held a series of important administrative assignments, culminating in 1961 with his appointment as Head of the Department: Deputy Dean of Engineering in 1945; Associate Director of the Laboratory for Nuclear Science and Engineering, 1946-52; and Chairman of the Faculty from 1952-54.

Dr. Gilliland was the first to receive the Bakeland Medal of the North Jersey Section of the American Chemical Society, and he also held the A.C.S. Industrial and Engineering Chemistry Award (1959); from the American Institute of Chemical Engineers he won the Professional Progress Award (1950), the William H. Walker Award (1954), the Warren K. Lewis Award (1965), and the Founders Award (1971).

Dr. Gilliland chose to relinquish leadership of the Department of Chemical Engineering in 1969, when he became the first to occupy the Warren K. Lewis Professorship; he became Institute Professor in 1971.

Alumni Calendar

Atlanta—May 8, Tuesday—Dinner meeting at 7:00 p.m. at Midnight Sun Restaurant, Peachtree Center. Speaker: Chancellor Paul Gray. Topic: The Making of Tomorrow.

Baltimore—May 10, Thursday—Peter Richardson to meet with alumni.

Chicago—June 7, Thursday—Final dinner meeting of year, Speaker: Paul Gray.

Dayton—May 8, Tuesday—Dinner meeting at 6:00 p.m., at Imperial House South, Interstate I-75. Speaker: Provost Walter A. Rosenblith. Topic: Some Lively M.I.T. Dimensions.

Houston—May 17, Thursday—President Jerome Wiesner will meet with alumni.

Miami—May 8, Tuesday—Vice President Kenneth Wadleigh to be guest of M.I.T. alumni.

Portland, Maine—May 10, Thursday—Dinner meeting at 7:00 p.m. at Holiday Inn, Portland. Speaker: Frederick G. Lehmann, Financial Vice President and Treasurer, Alumni Association. Topic: Inside M.I.T.

San Juan—May 10, Thursday—Area alumni preparing event to honor Chancellor Paul Gray.

Tampa—May 10, Thursday—Vice President Kenneth Wadleigh to meet with alumni.

Individuals Noteworthy

Professional and corporate changes: **John W. Brackett**, '59, to Vice President of Software Production at SofTech, Inc. . . . **Norman L. Laschever**, '40, to Manager, Planning, for R.C.A. Aerospace Systems. . . . **J. Robert Ferguson, Jr.**, '37, to President of U.S.S. Engineers and Consultants, Inc., a subsidiary of U.S. Steel Corp. . . . **Louis G. Peloubet**, '49, to Vice President-Controller of Textron, Inc. . . . **Ernest Lustig**, Ph.D.'57, to Director of Spectroscopy Department, Association for Molecular Biology Research, Braunschweig, West Germany. . . . **Daniel Hyman**, Sc.D.'52, to Manager of Engineering Research, Process Engineering Department, American Cyanamid. . . . **J. D. Erickson**, '53, named a Vice President of the aluminum division of Kaiser Aluminum and Chemical Corp. . . . **Haim Kennet**, '56, to Manager of Boeing Aerospace Co.'s Mariner Venus-Mercury effort. . . . **Robert L. Mitchell**, S.M.'57, to Group Vice President of Celanese Corp. . . . **Margaret T. Coleman**, '50, to Manager, Analysis and Development, the Wm. Underwood Co. . . . **Willard L. Morrison**, '40, to

Director of Research and Engineering for The Washington Group, Inc. . . . **Norman M. Edelson**, '51, to Manager of Process Engineering, Corning Glass Works. . . . **Robert F. Seedlock**, S.M.'40, has joined Parsons, Brinckerhoff, Quade, and Douglas as an Associate of the Firm. . . . **Stanley M. Bloom**, '53, to Assistant Vice President, Polaroid Corp. . . . **J. Herbert Hollomon**, '40, elected to the Board of Directors of Avco Everett Research Laboratory, Inc. . . . **C. Vincent Vappi**, '48, elected to the Board of Directors of John Hancock Mutual Life Insurance Co. . . . **Arthur H. Kuljian**, '48, to Chairman of the board of the Kuljian Corp. . . . **Thomas C. Vicary**, '64, to Manager—Marketing, Erie City Energy Division of Zurn Industries, Inc. . . . **William H. Schenkle**, '51, to Vice President of Engineering, Municipal and Utility Division of Rockwell International. . . . **Albert M. Clogston**, '38, to Executive Director of the Research-Physics and Academic Affairs Division of Bell Laboratories. . . . **Ezra R. Armstrong, Jr.**, '65, has joined the J. M. Smucker Co. as Manager of Marketing Research. . . . **Ford R. Park**, '46, has joined Xerox Corp. as Editor of Corporate Publications. . . . **Walter J. Humann**, '59, elected a Vice President of The L.T.V. Corp. . . . **Djoerd Hoekstra**, S.M.'61, to Manager of Commercial Development for Pennwalt Corp. . . . **Robert J. Corless**, '47, promoted to Group Vice President of National Gypsum Co. . . . **Walter L. Milliken**, S.M.'46, to Area Manager-Sales of du Pont's Industrial Chemicals Department. . . . **Robert M. Langelier**, '59, appointed a Vice President of Computer Sciences Corporation's Systems Division. . . . **Nicholas Shoumatoff**, '39, has joined I.T.T. Rayonier Inc. as Director of Project Planning and Development. . . . **James M. Chorak**, '57, to President of Hughes Communications International, Inc. . . . **Ignacio Arango**, S.M.'58, promoted to Staff Consultant, Dynamics at Shannon and Wilson, Inc. . . . **Stephen S. Flaum**, '67, to Manager Engineering Department, S. and S. Corrugated Paper Machinery Co., Inc. . . . **Scott O. Graham**, '65, has joined the scientific staff of R.C.A. Laboratories at the Sarnoff Research Center. . . . **Allen C. Potter**, '53, to Director of Engineering at Torin Corp. . . . **Robert J. Condap**, '68, to Vice President—Marketing for Flex Key Corp. . . . **Mark C. Porter**, '60, to Vice President of Research and Development for Nuclepore Corp. . . . **Oleg V. Fedoroff**, S.M.'63, appointed Director of Operations Research for Braddock, Dunn, and McDonald Inc. . . . **Cyril H. Brown**, '47, to Manager, Advanced Product Planning at Analog Devices, Inc. . . . **Michael L. Finson**, '63, to Chairman of the Aerophysics Research Committee at Avco Research Laboratory. . . . **William L. Fader**, S.M.'41, to Vice President-Eastern Steel Operations for United States Steel. . . . **Gerald D. Laubach**, Ph.D.'50, named President of Pfizer . . . **Robert I. Mason**, '43, appointed Director of Marketing in the Process Chemicals Division of Hercules Inc. . . . **James B. Weaver**, '44, to Vice President, I.C.I. America Inc. . . . **S. W. Carter**, S.M.'58, to President for 1973, Florida Phosphate Council.

Special appointments: **Avron Spector**, '54, appointed to a year's stay with the Federal Aviation Administration through the Presidential Executive Interchange Program. . . . **Donald L. Thomsen**, Ph.D.'47, to President and Executive Director of the non-profit Society for Industrial and Applied Mathematics' Institute for Mathematics and Society. . . . **James G. Poor**, '59, to Director of the Atomic Energy Commission's Division of International Security Affairs. . . . **Robert McCormick Adams**, '46, to Chairman of the Assembly of Behavioral and Social Sciences of the National Academy of Sciences.

University appointments: **James B. Conklin**, to Associate Director for Instruction and Research Computing at the Information Services division of the University of Florida. . . . **Albert H. Teich**, '64, named Coordinator of Research and part-time Assistant Professor of Political Science at the State University of New York at Binghamton. . . . **Dave L. Bowler**, S.M.'51, to Full Professor at Swarthmore College. . . . **F. Brown Whittington**, '58, has been promoted to Associate Professor in the School of Business Administration at Emory University. . . . **William T. Hogan**, Sc.D.'59, to Dean of the College of Engineering at Lowell Technological Institute. . . . **Morris F. Shaffer**, '30, to Dean for the Graduate School of Biomedical Sciences at the College of Medicine and Dentistry of New Jersey. . . . **Herbert C. Doepken, Jr.** '63, to Affiliate Associate Professor in Electrical Engineering at Worcester Polytechnic Institute.

Awards and honors: the Atomic Energy Commission's Distinguished Service Award, to **Angelo Giambusso**, '48. . . . to **Conrad Schuerch**, '40, the Syracuse Section Award for 1973 presented by the Syracuse Section of the American Chemical Society. . . . to **Albert C. Hall**, Sc.D. '37, the Department of Defense Distinguished Public Service Medal. . . . The Worcester Engineering Society's Scientific Achievement Award for 1973 to **W. Maxwell Wheildon**, '30. . . . to **Dwight Kennard**, '61, the Air Force Air Medal. . . . **William R. Hewlett**, S.M. '36, was presented the Founders Medal by I.E.E.E. . . . **Frank R. Milliken**, '34, named "Copper Man of the Year" by The Copper Club. . . . to **M. V. Mathews**, Sc.D. '52, the David Sarnoff Award by I.E.E.E. . . . to **Jay W. Forrester**, S.M.'45, the Electrical Society of New England's New England Award. . . . to **Walter J. Hamburger**, '21, the Polytechnic Institute of Brooklyn's Distinguished Alumnus Award.

Deceased

Harrison I. Cole, '91, June 21, 1971
William H. Kimball, '99, February 23, 1973*
G. Huntington Clapp, '03, April, 1965
Arthur S. Gibbs, '03, August 30, 1971
Albert C. Ferry, '04, October 3, 1967
Moise H. Goldstein, '04, December 28, 1972
Charles R. Adams, '05, July 25, 1971
Harry P. Charlesworth, '05, December 30, 1972
George I. Rhodes, '05, December 6, 1972
William George Abbott, Jr., '06, November 22, 1972
Alfred G. Long, '07, May 12, 1972
Edwin G. Kinter, '08, February 5, 1971*
Franklin L. Hunt, '09, December 23, 1972*
Merrill W. Tilden, '10, December 1, 1973
John F. Alter, '11, February 5, 1973
Samuel L. Hayes, '11, February 14, 1973
William O. Whitney, '11, January 5, 1973
Edmund L. Homan,'12, July 6, 1972
Willis R. Salisbury, '12, January 10, 1973
Walter H. Triplett, '12, November 21, 1972
William S. Gilmore, '13, July 3, 1972*
George E. Hodge, '13, February 22, 1973
Victor Mayper, '13, June 23, 1972
Max L. Waterman, '13, January 19, 1973*
Ralph E. Wells, Jr., '14, April 8, 1969
Maurice F. Brandt, '15, January 10, 1973
Harold B. Pickering, '15, February 19, 1973
E. Blythe Stason, '16, April 10, 1972
Arthur A. Carter, '17, February 20, 1973
James P. Ferrall, '17, December 29, 1972*
William T. Haines, '17, October 14, 1968
Carl H. Leander, '20, January 19, 1973*
Edmund C. Sullivan, '20, March 9, 1973
Thomas P. Campbell, '21, April 8, 1972
Harry A. Goodman, '21, March 24, 1973
Everett J. Wilson, '21, February 2, 1973

M. Ewart Hurst, '22, March 9, 1973
George W. King, '22, January 16, 1973*
Winslow C. Morse, '22, February 1, 1973*
Bennett Myers, '22, August 26, 1968
Lloyd E. Raymond, '22, January 12, 1973
Jose C. Bertino, '23, June 11, 1972*
Henry F. Culver, '23, August 15, 1972
Lucien M. Grant, '23, October 4, 1971*
Harold D. Hersum, '23, April 6, 1971
William C. Hull, '23, December, 1966
William F. McNary, '23, February 3, 1973*
Bert H. McQueer, '23, July 27, 1955
Walter E. Richards, '23, June 21, 1972
Aaron H. Stern, '23, November 29, 1968
Gordon F. Eaton, '24, March 7, 1973
Norman H. Evans, '24, November 23, 1972*
Norris Johnston, '24, December 17, 1972*
F. Graham Cunningham, '25, January 30, 1973*
Mrs. Henry T. Waters, '25, April 28, 1972*
Gostan Gostanian, '26, January 27, 1973
Norris Johnston, '24, December 17, 1972*
Cedric M. Thompson, '26, October 15, 1971
J. Robert Bonnar, '27, February 12, 1973*
Harvey A. Fitts, '27, February 11, 1973
Meyer G. Garfinkle, '27, February 13, 1973
Robert W. Hancock, '27, January 13, 1973
Paul S. Vaughan, '27, April 11, 1972
Walter C. Crossley, '28, December 17, 1971*
Grandison Gardner, '28, January 19, 1973
John F. McGrath, '29, January 19, 1972
Delbert Warburton, Jr., '29, January 17, 1973
Mrs. Frances Frazier, '30, February 15, 1973
Julius Brody, '32, October 22, 1972
David C. Leonberger, Jr., '32, April 22, 1970
Edwin R. Gilliland, '33, March 10, 1973
Henry B. Kroger, '33, November 15, 1969
Peter Barry, '34, January 23, 1973*
John T. Fisher, '34, March 1, 1972
Harold M. Oskry, '35, February 6, 1973*
Joel B. Bulkley, '36, November 19, 1970*
Richard K. Koegler, '36, November 3, 1971*
Thomas Evans, '38, February 22, 1973
Eugene B. Weisberg, '38, July 24, 1970
Adrian A. McCroskey, '39, May 17, 1969
John W. Horner, '41, January 27, 1973
Joseph W. Paquette, '41, April 29, 1968
Norton Polivnick, '41, March 2, 1973
Cecil E. Spruill, '44, January 31, 1967
Mrs. Margia H. Abbott, '46, June 30, 1972
Juan I. Irigoyen Arzu, '48, n.d.
D. Anson Isely, '48, August 4, 1971
John T. Clarke, '49, January 17, 1973
Stanley N. Kuryla, '49, March 12, 1973
George P. Lunday, '50, December 22, 1972
Victor G. Macres, '53, December 31, 1972
William F. Clough, Sc.D.'54, May, 1972
John B. Maybee, '54, April 13, 1972
Walter E. Weissblum, '55, November, 1966
Cheng-Huai Li, '64, June, 1970
Ronald B. Perlman, '66, December 14, 1971*
Jaime R. Carbonell, '70, February 2, 1970

*Further information in *Class Review*

Class Review

96

Spring has reached Washington in its northward journey and should reach you by the time these Notes are in print. Our three members are all in the "snow" belt—upper New York state, New Hampshire and Maine. I was unsuccessful in my attempts to contact Dr. Coolidge on my last trip, but will try again next month. —**Clare Driscoll**, Acting Secretary, 2032 Belmont Rd. N. W., Washington, D.C. 20009

98

The Jones enjoyed the desert in bloom—a sight new to your Secretary. We left Homestead, Fla., with our trailer the last of March. Arizona and Colorado are a long way from Massachusetts but those states are on our route home. Soon you will receive your Reunion brochures, mailed in April. It would be a real treat to meet you at the Institute for your 75th Reunion, the first weekend in June. Please let me know if you are going and if I can help you in any way.—Mrs. **Audrey Jones Jones**, Acting Secretary, 232 Fountain St., Springfield, Mass. 01108

99

The family of **William H. Kimball**, 906 Mississippi Ave., Davenport, Iowa have informed us of his death on February 23, 1973. There was no further information.—**Norman E. Seavey**, Acting Secretary, Apt. 514 Lucerne Towers, Orlando, Fla.

03

Well, my distant yet lovable classmates, a personal interview with your aging yet active Secretary (92 years by April 1), would be an exciting climax to our long and interesting companionship.

The New England winter seems at last on its wane, with daily temperatures less in the thirties for a few classmates unable to enjoy the balmy atmosphere of Florida or lower California. Our M.I.T. research engineers have yet to solve our loss of solar heat and conservation of limitless lost heat units to the daily atmosphere that pervades humanity.

An unusual letter has been received at the *Review* office from Mr. E. James Gambaro, prominent architect in New York City, regarding our distinguished '03 Classmate, Architect **Raymond M. Hood**.

Raymond passed away in 1934, after a short but exciting career with national and international achievements. Among his designs was Rockefeller Center and he was a pioneer in the skyscraper development of New York City.

However, a renewal of Raymond M. Hood's distinguished career creates an embarassing problem for all Class Secretaries' reports and is worthy of note at our next Secretary ensemble.

A change of address for **George H. Garcelon**, now at 55 Cooper St., Agawam, Mass.

William C. Lounsbury has passed away December 12, 1972.

Editor's Note: We would like to extend birthday greetings to Mr. Nolan as he just celebrated his ninety-second birthday.—**John J. A. Nolan**, Secretary/Treasurer, 13 Linden Avenue, Somerville, Mass. 02143

04

The Alumni Office forwarded a short note from **Robert Phinney** stating that he celebrated his 90th birthday with a party of nearly 100 people at the First Unitarian Church of Rochester on December 10, 1972. Congratulations Bob.

I received a letter from Miss Elese Kaiser informing me that her father, **George Kaiser** passed away in October 1972. They were on a trip to Mexico City and had visited other cities in the South when he collapsed and died of a heart attack. Prior to leaving, his physical condition was checked and apparently there were no indications of physical difficulties. George and his daughter did a great deal of traveling in his later years and contributed many interesting articles to the class news, detailing happenings on these trips.

Referring to notes in the last issue of the *Review,* Robert Bates reports that his father **George Bates** died in Great Falls, Montana where he made his home almost continuously from the day of his graduation.—**Eugene H. Russell, Jr.**, Secretary, 82 Stevens Rd., Needham, Mass. 02192

05

Through the kind interest of Richard V. Westerhoff, '57, I learn of the death of **George I. Rhodes** of Glen Ridge, N.J. on December 6, 1972. My efforts to get further information have been ineffective. George was a constant attendant at our Five Year Reunions. I know that up to a few years ago he enjoyed golf greatly.

Harry Kendall is again in Hawaii. He spends several months there each winter. . . . A letter from **George Prentiss** tells little about the Prentisses but does ask for a lot of statistics. Perhaps the readers can help on this one. "How many of us followed out engineering?" I can think of a few who did not. A graduate in Naval Engineering who later became a priest. A couple of Mechanical Engineers who became Directory Publishers. Can you add to this category? Harry asks also, "Did we have drop-outs in our day?" Six hundred men and seven girls entered with us in 1901 and 244 graduated. Were these drop outs or those who flunked out?

One of our better correspondents, **Sam Seaver**, of Markham, Ontario, writes that after a very complete physical his doctors tell him he's a tough old nut and that he should avoid cold drinks. I don't remember if Sam was long on cold drinks, but there are substitutes, Sam. He adds, "I still work a few hours each day in my shop making furniture, carving, etc. Made, carved and lined 13 jewel boxes." How about some of you other fellows telling us of your skills and accomplishments. I do know that **Gilbert Tower** is very active working in civic affairs and town planning. Here's hoping there will be plenty of responses. I know that what does not seem "news" to you will be good news to your classmates.—**Fred W. Goldthwait**, Secretary-Treasurer, Box 231, Center Sandwich, N.H.; **William S. Ball**, Assistant Secretary, 6311 Fordham Place, Bayshore Gardens, Bradenton, Fla. 33505

08

We have received another report from a classmate, **Henry R. Sewell** of Norwell, Mass. He graduated from the high school in Hastings, Neb., and started work in a steel mill in Pueblo, Colo., as clerk in the repair department. Some M.I.T. engineers

in the main office suggested that he go to Boston and become a technical engineer. He started with our Class in 1904, "After three years I found the work difficult and had to drop out. So with a fraternity roommate in the same circumstances, I went to Chicago, found a job as draftsman with the Grand Crossing Track Co., at their open hearth steel mill. I later worked for Western Electric as a draftsman. The pay was $16 per week versus $9 at the steel mill.

"I later decided to move to Texas and was hired by the Brush Electric Light and Power Co., in Galveston, Texas, where they were remodeling their power station. That work lasted over a year, with a term of factory education at West Allis, making me an Allis Chalmers man, and then back to Houston, Texas. Had a part in planning and installation of the first and second left irrigation pumping stations at San Benito and McAllen.

"In Houston I met Mrs. Sewell, a Smith College graduate '07. I came back to Boston, left Allis Chalmers, and took a position with B. F. Sturtevant Co., in Hyde Park, Mass., taking over the Steam Engine Department. I married and soon sertled down. The steam engine business dwindled to small vertical engines to drive the cane and bagasse conveyors in sugar mills. Sturtevant had a large fan business in ventilating, conveying, forced and induced draft fans. They were considering a European factory and sending me over as manager. Two older M.I.T. men from Boston had established a company in England selling Hyde Park Equipment called the Sturtevant Engineering Co., Ltd.

"In May, 1920, I was sent with Mrs. Sewell to England to see what this English company did and to visit their office in Paris. I found that this English company was so well established that we could not locate another factory there. In 1921, Mrs. Sewell and I were sent to promote air conditioning in Japan and business in China. We left Kobe on Christmas eve, and the next day were on the Inland Sea of Japan on the way to Shanghai.

"It was going through the lobby of the old Astor Hotel in Shanghai that I met **Bill Adams**, '08. Bill had a Fire Insurance Agency, but his main activity was secretary of the American Club there. I had a long talk with him. When the Japanese took over China, Bill came back to Boston and visited old friends in Milton. The last time that I saw him was in the Blue Hill Reservation. He told me that now that the Japanese were out of China, he was going back to Shanghai. This he did, but only lived a few years.

"In 1923 we visited our agent in Manila, who was considering equipment drying of coconut meat. Then on down to Australia and New Zealand. In January, 1922, business was declining in China. We visited Tiensen and Peking.

"At home, I eventually became a Vice President and General Manager of the Sturtevant Cooling and Air Conditioning Corp. Sturtevant was sold to Westinghouse in 1940 and I was retired by Westinghouse in 1950 at 65 years of age.

"That winter, Mrs. Sewell and I drove to California to visit our daughter, the wife of a Physics Professor at the University of California in Berkeley. While in California I received notice that I had been elected Vice President of South Scituate Savings Bank.

"I had to retire in 1973 according to Massachusetts state laws. I was 84. We are still living in the Norwell house that we built in a blueberry pasture 36 years ago." . . . We are sorry to report the death of Captain **Edwin G. Kinter** on February 5, 1971 a naval construction engineer at Washington, D.C. as reported by his daughter at 24 Sussic St., Rehoboth Beach, Del. 19971. Only one change of address this month and that is for the naval architect **Arthur F. Mohan** to 110 El Regaz St., Heliapalis, Cairo, Egypt. Please remember to register for the Mini-Reunion held Sunday June 3 from 5-6 p.m. in the Student Center.—**Joseph W. Wattles**, 26 Bullard Rd., Weston, Mass. 02193

09

It was with great pleasure that we received a note from **Harold Stewart**, since we had not heard from him for some time. He was a member of our Course VI group drawn together in our early struggles with kilowatts and Ohm's law. After graduation he began his career as an electrical engineer with the Rochester Gas and Electric Corp., with which he remained until his retirement in 1954. He writes: "I want to thank you most sincerely for the many informative articles you have written for our Class as Secretary over all these years. The following notes will give you an idea of what I have been doing. I quit work in May 1954 and then began, to the fullest extent, to enjoy outdoor life. We moved to our cottage on Conesas Lake and for the next 18 years stayed there each year until cold weather set in. Most of all we enjoyed sailing, canoeing, flower and vegetable gardening, driving around various sections of the beautiful Finger Lakes. Each year in February we drove to Florida and stayed there three months. There was plenty to do and see in the winter time. During this period we often flew to one of the beautiful Caribbean islands for two weeks of sightseeing. My wife, Marguerite Dudley Stewart, formerly of Milton, Mass., and I have had a wonderful life together. We have three children, nine grandchildren and one great-granddaughter. As I looked out of our windows this morning (January 29) the snow was blowing around wildly and the temperature had dropped to ten degrees. It reminded me of a trip six of us took to the White Mountains between first and second terms in 1909. The most exciting part of it was a hike to the top of Mt. Washington on snowshoes. It was so sunny and warm as we started up the slope, but each mile was much colder. When we reached the summit, it was 50 degrees below zero! The wind was so strong that we could not stand up facing it to look over the top. So we had to crawl! It was a most thrilling experience for all of us. For the return trip each of us placed a board across the wide cograil and slid down. As I remember, our group consisted of Bob Doane, Phifer Smith, George Thomas, Francis Dunnington, **Phil Chase**, and myself." We all remember George Thomas, who was an instructor in Professor Laws' electrical measurements laboratory and was so helpful to all of us. Phil Chase, who retired some time ago as Chief Engineer of the Philadelphia Electric Co., spends his summers at Kennebunk Beach, Maine.

It is with much regret that we report the deaths of several classmates. **Ralph Edward Irwin**, Course VII, died in 1970 at Camp Hill, Pa. Our records show that for several years he was an engineer with the State Department of Health, Harrisburg, Pa., and that he moved to Camp Hill in 1948. . . . **Lockwood Towne**, Course I, died December 19, 1972, at Danbury, Conn. He prepared for the Institute at DePauw Academy and DePauw University ('05). At the Institute he was a member of the Executive Committee of the Civil Engineering Society. "In November 1909 he married Miss Helen Jones. After teaching civil engineering at the University of Nebraska and the University of Illinois he joined Stone and Webster Engineering Corp., Boston and New York, from which he retired in 1950. He was a former consultant to the Connecticut Highway Department, a member of the Hoover Commission, the American Society of Civil Engineers, and Saint Paul Episcopal Church in Brookfield. He leaves his wife, a daughter, Mrs. Merrill T. Hunt, a son, Dr. Lockwood Towne of Westport, five grandchildren and seven great-grandchildren. We have written to his widow expressing the sympathy of the Class as well as our own.

George Hodsdon, Course III, died December 21, 1972, at Fort Meyers, Fla. Our records show that he left the Institute after his sophomore year and lived a few years in Gloucester, Mass., before moving to Florida. . . . **Franklin Hunt**, Course VIII, died December 23 in Burlington, Vt., at the age of 89. He prepared for the Institute at Waltham High School and after the bachelor's degree at M.I.T. he earned a master's degree at Harvard and a Ph.D. in physics at M.I.T. For some time he was a member of the M.I.T. faculty. During World War I he performed research on air speed indicators, then became a physicist at the Bureau of Standards. From 1929 until his retirement in 1948, he worked as a physicist at the Bell Laboratories. He leaves a son, Allen of Burlington, a daughter, Mrs. David Dodge of Bethesda, Md., and five grandchildren.

Russell P. Westerhoff, '27, of Ridgewood, N.J., has written to advise us of the death of **Harry E. Whitaker**, Course VI, on February 13, 1973, in a nursing home in Longbranch, N.J. Harry had not been well for years and had been in a nursing home for a long time. He prepared for the Institute at Newton High School at the time your Secretary was a student there. At the Institute he held many offices—captain of the relay team, class treasurer, senior portfolio committee, and third marshall, Class Day. After graduation he worked for a power company in Colorado. In 1919 he joined the engineering firm, Ford, Bacon and Davis, Inc., New York, where he rose to the position of Chief Engineer, Vice Presi-

dent and Director. He retired in August 1951. Mr. Westerhoff worked with Harry at Ford, Bacon and Davis. Many of you will remember that Harry attended our earlier reunions until prevented by poor health.—**Chester L. Dawes**, Secretary, Pierce Hall, Harvard University, Cambridge, Mass. 02138

10

Russell Hastings wrote in reply to your Secretary's letter of September 28, 1972. "In my case I have been unable to keep up with M.I.T. affairs the way I used to do although I am still living at 16 Emerson. I find *Tech Review* one of the most interesting publications I have. My eyes are bothering me some however, so I don't read as much as I used to. Mrs. Hastings passed away last Spring." . . . Romalda and **Walt Spalding** are both in excellent health and enjoying the home Walt designed and built 23 years ago. Walt writes that, "it is 850 feet above the city but only 12 minutes drive down to Honolulu's business center, and our view extends about 270 degrees, from Waikiki on the south, over the city and airport to Pearl Harbor and two mountain ranges to the north. The lawn and some 33 trees give us enough exercise but our work revolves around Romalda's teaching teachers how to use our book, *The Writing Road to Reading* (William Morrow and Co.)

"She recently taught a class of 37 teachers her regular 40-hour course in the Spalding method at a nearby school. Last June we flew to New Bedford, Mass., where she taught it to a class of 148 teachers at Southeastern Mass., University. This all involves much correspondence. More than 50 thousand of our books have been bought since it was first published in 1957.

"We recently served as Republican election officials in the local primaries. When President and Mrs. Nixon and Premier Tanaka of Japan were meeting recently at the beautiful, new, Kuilima Hotel, about 60 miles away, we spent a few days there on holiday."

Ludwig Rosenstein writes "I have been away from San Francisco which resulted in the misplacement of some of my correspondence. It is believed that I will be able to complete an account of my activities and have it in your hands by about the end of this year. I was grieved to hear that only 61 of us 1910ers have survived. We had such a good show at the 50th Class Reunion."

Allan Gould writes of his recent activities, "one thing rather special was a contact I had this summer at Chatham with **George Lunt** when we were both in the same inn for several days. He told me of a number of experiences he had with Thomas Edison before graduation, I believe, and over many later years. The friendship was both personal and technical. George was evidently in on a number of Edison's early projects, though George was too modest to say much about particulars. I told George that he ought to write up these historic visits with Edison and let at least the M.I.T. public in on them."

Robert F. Burnett writes, "we are now living at West Davenport in Upstate New York, near Oneonta. One of our sons has a 160-170 acre farm, and we have a very comfortable new house built on his property. The location is pleasantly situated beside a river, which flows into the Susquehanna."

George R. Lord writes that he was 86 last January. "Still living with wife in Clearwater. Had a heart attack in January 1971 which has severely handicapped my activities, particularly travel and work in yard as well as writing. We have had a very hot and dry summer but Clearwater, in fact all of Florida, is growing by leaps and bounds. Have been retired for 20 years this month. Most of my acquaintances at Tech seem to have passed on. Have two children, four grandchildren (all married) and four great grandsons, all living in north."

We have a note from Lois Rodman who tells of the passing of our classmate. "**Sam Rodman** died on October 9, 1972. He retired as Vice President of The Connecticut Bank and Trust Co., in 1953 and moved to Sarasota that same year. He loved it here and enjoyed his boat, fishing, golf and swimming, right up to the end. His retirement was a happy time for him. I am sorry he couldn't answer your letter himself."—**Herbert S. Cleverdon**, Secretary, 35 Windmere Rd., Wellesley Hills, Mass. 02181

11

I recently received a half-page clipping from the October 8, 1972, *Oregon Journal* about **Ormand Bean**. He has really been an important man in Portland. His many public offices were recorded in these notes for November, 1967; April, 1969; and March, 1962. Listing some of them: He was Head of the Public Works Department of Portland, and the Oregon Public Utilities Commission; Director of the Office of Defense Transportation for Hawaii, Puerto Rico, and the Middle East during World War II; a member of the Portland City Council; and retired six years ago from the Portland Commission of Finance. His wife passed away about two years ago and his health failed, putting him in the hospital for five months in 1972 and into the Park View Nursing Home of which he is President. He is now living in the Terwillinger Plaza Apartments overlooking Duniway Park which he helped to acquire for the city. He is busy collecting and indexing thousands of clippings about Portland and his part in its progress. A couple of quotations from his notes while he was working for the city indicate his philosophy: "Any employee found to have acquired an interest in any land adjacent to any planned city improvement will be dismissed." and "Don't fool yourself by thinking your ability has resulted in your success; it may have been your luck."

Ralph T. Walker, one of our famous classmates, died in January. He was hailed in 1957 as the Architect of the Century by the American Institute of Architects, which he helped to form and of which he was a past president. Ralph was born in Waterbury, Conn., attended high school in Providence and graduated in architecture with us. He was a member of the architectural firm Voorhees, Walker, Smith and Smith and was responsible for the design of many notable buildings including several of those at the New York World's Fair in 1939-40. He has been Vice President of Union Internationale des Architectes; a member of the National Institute of Arts and Letters and the National Academy of Design; a past Director of the Regional Plan Association; and a former President of the Municipal Art Society. In 1959, Ralph was appointed by President Eisenhower to the Commission of Fine Arts which supervises planning in Washington. These are just a few of the many honors that came to Ralph Walker.

John F. Alter of Carlisle, Mass., another of our classmate architects, died February 5. He was born in Austria in 1882, prepared for Tech at the Lawrence High School and it was in Lawrence that he practiced architecture for many years. He and his wife, Margaret, were at our Fifty-Year Reunion in Harwich Port. After his wife's death in 1968, John moved to Carlisle.

I have several address changes to report: First a correction for Allston T. Cushing, John Knox Retirement Village, 514 North Murray Rd., #C204, Lees Summit, Mo.; Ove Collett, Curt Adelers Qt. 16, Post Box 2428; Solli, Oslo 2 Norway; Minot S. Dennett, 4725 Cove Circle #805, St. Petersburg, Fla.; Stafford A. Francis, C/O Wm. F. Newhill, 2404 E. Lake Huitridge Dr., Winter Haven, Fla.; Harold L. Robinson, C/O R. S. Robinson, Lake Rd., Brookfield, Mass.—**Oberlin S. Clark**, Secretary, 50 Leonard Rd., North Weymouth, Mass. 02191

12

Here, near Philadelphia, we have had a very mild winter, with temperatures generally above freezing and there has been no snow.

We are happy to hear from **Harold Danser** of Belmont, Mass., who writes that he is in good health and takes frequent auto trips. He sends a quotation of which he is particularly fond, which is titled, "Don't Worry". "If you ask my advice I say 'Don't Worry!' Why should you? There are only two things you could worry about, either you are well or you are sick. If you are well, then there should be nothing to worry about, but if you are sick, there are two things—either you will get well or you will die. If you get well, there is nothing to worry about, but if you die there are two things to worry about,—either you will go to heaven or you'll go below. If you go to heaven, there is nothing to worry about, but if you go below, you will be so darn busy shaking hands with friends, you won't have time to worry."

Jonathan Noyes wrote that he planned to attend the big M.I.T. Alumni Festival in Mexico City which was held in March, and one of his grandsons would accompany him. He attended it last year and had a great time, though he was our only Class representative. The guest speaker this year is President Jerome B. Wiesner. . . . **Jay Pratt** and Priscilla

spent several weeks this winter at their favorite spot in Acapulco, Mexico, which they both love so much. We are most pleased to know that their health has returned, making this trip possible. . . . A note from **Walter Slade** indicates that he has recovered appreciably after several hospital trips. Our very best wishes, Walter!

In this issue we are, for the first time, including the following communications from widows of our classmates, who continue to be interested in our Class of '12 column. Our records indicate that there are presently about 24 widows in this group, and maybe more not so listed. We hope that we shall hear from others shortly.

Mrs. **Arch Eicher**, Agnes, writes, "How nice to know that you have decided to carry on your interesting work as Class Secretary. Since Arch died, I have made no drastic changes in my life style. I am still living in our little house in Cleveland and plan to stay here until some big reason forces me to move. I am close enough to my daughter and family so that I have more than a busy schedule. Grandmothers have been known to baby-sit even when the children are not longer babies. I am truly sorry that I did not attend the 60th Reunion last June specially since there was such a lovely memorial service for those men who had passed away last year. I plan to go to Florida in April for about two weeks, staying with a friend, and then hope to get over to Dunedin to see Marion Lenaerts." . . . Holly Hanson, daughter of Edith and **Hugo Hanson** was visiting her mother in St. Petersburg and wrote me a note. She says her mother's eyes have failed to such an extent that she can no longer see to read. Her general health is below par, but she still has a good sense of humor and was pleased to hear from me. "She did visit us in Colorado for several months last year. She now has twelve grandchildren and seven great-grandchildren. My brother John, M.I.T. '47, is an architect in New York City. Brother Hugh, Princeton '48, is director of marketing for Weyerhauser and lives in Concord, Mass. I live in Colorado with a family of five sons and seven grandchildren." . . . Mrs. **David Guy**, Iva writes from Washington, D.C., sending the following story about Dave. "Among the many tributes to David which I received at the time of his death, were three which I most cherish, pertaining to his work in Alaska many years ago. Joe Flackne, then in the Interior Department, wrote of 'his great kindness and help'. Ted Stevens, U.S. Senator, 'I recall David's association with the efforts to secure statehood for Alaska.' Nick Begich, Congressman from Alaska (lost last year in a plane crash with Hale Boggs on an Alaskan flight) wrote, 'Since my arrival in Washington, and long before in Alaska, I have heard many fine accounts of the wonderful work your husband, David, did for Alaska. The Chamber of Commerce, through his leadership, was active in assisting Alaska as a territory and did pioneer work in the fight for statehood. His was a masterful effort, and it has been much appreciated throughout the State. David never 'tooted his own horn' so any word of his accomplishments had to come from others."

We are hoping to hear from at least a dozen classmates that they will plan to attend our Mini-Reunion on Sunday, June 3, 1973, which is planned by the Alumni Day Committee for those classes not holding a formal reunion this year. The event was outlined in our last issue and additional information appears in this section of the May *Review*. The Committee will arrange for rooms, probably at McCormick Hall and we will enjoy the International Buffet at 5 p.m. and the Boston Pops concert in the evening. In addition, our own Class will have a get-together. **Al Davis**, our President and Reunion Chairman, writes that he would like to host all classmates who attend, picking up the tabs for drinks and snacks. Please write promptly.—**Ray E. Wilson**, Secretary, 304 Park Ave., Swarthmore, Pa. 19081

13

Well, our 60th Reunion plans are beginning to "gell." The bus company has given us a confirmation of our tour of New Boston. **Heinie Glidden** is preparing slides of Old Technology on Boylston Street, Boston, and other nostalgic scenes of the days we remember. More good news: we shall be housed in McCormick. Of course, Jo and **Bill Mattson** will join us for our 60th. Heinie (Henry) Glidden writes and we quote in part: "Jane had an accident in late December. Herewith is my belated reply confirming our intent to be at the Reunion in June. Sorry it got mislaid, but many things do these days as I am nurse, cook, housekeeper and errand boy while Jane's broken ankle mends. Since December 21 when she had the accident, Jane has not been yet allowed to put her weight on the right foot, and has left the house only to make the two trips to the doctor's office. There is some time, of course, before June 1, and we are hoping for much improvement by that time. I'm sorting out slides that might be appropriate to show—some of Reunions, M.I.T. buildings, etc. We often speak of your very homey place in Biddeford, and our nice visit there last summer."

Lloyd A. Hechenger states: "Retired Science Teacher in the Boston Latin School and Chamberlayne Junior College." . . . **Walter Muther** reports: "I had been ailing a little with low pulse (40) for about a year and a half. In December I got an additional pump put in a pacemaker. Now it hits 72 on the nose regularly. I'm rejuvenated. The chances are my left hernia (that weak point in man) will have to be fixed before long. Otherwise have only the usual complaints of the aging. It's certainly been a cold winter so far, but remember, 'If winter comes, can spring be far behind?' Sally joins me in sending best New Year's wishes to you and your good wife."

We have received a lengthy resume from **Earl R. Lincoln**, P.O. Box 65, San Joseph, B.C., which recorded his life's endeavors since leaving M.I.T. in his Junior year as a student in Chemical Engineering. He was associated with several of the electric and automatic telephone concerns both in the U.S. and Canada as a draftsman and supervisor. He became a Canadian citizen, and for many years has been a "Homesteader," with 470 acres on the northern end of Vancouver Island, B.C., and associated with the Canadian Air Force. his vast acreage includes many areas of virgin pine, spruce, hemlock, balsam, and cedar, which eventually will become valuable as logging sources. Earl is unmarried, but is happy as is.

Again, we must call your attention to our classmate, **George Wallace** of Fitchburg, Mass. He has been (now retired) a very successful paper manufacturer. He has been intimately associated with Winston Churchill, ex-President Dwight Eisenhower, a prime fund raiser for the Republican Party, but has assisted some Democrats, like his namesake, George Wallace of Alabama. Our George has many diversions: an accomplished organist (guest soloist) in a concert with Arthur Fiedler, a collector of antique autos, an expert fancy skater, an accomplished fancy diver. With his wife, Alice, he has donated to his city of Fitchburg a planetarium, library, recreation center, skating rink, and many other facilities, as well as sizeable donations to M.I.T. and other educational institutions in neighboring communities. All of George's contributions and social accomplishments are well described in the magazine of the *Worcester Sunday Telegram*, February 25, 1973. (Many thanks to **Warren Glancy** for sending your scribe a copy.)

Once again, it is our duty to announce the very sad news: **William S. Gilmore** of Woodlawn, Paget, Bermuda, passed away July 3, 1972. Our dear friend and classmate **Max L. Waterman** died January 19, 1973. Services for the retired Vice President of the Singer Manufacturing Co., were held in the Dennis and D'Arcy funeral home, 1046 Fairfield Avenue. The Reverend Howard C. Nutting, Pastor of the United Congregational church officiated. Burial was in Mountain Grove cemetery. Born in Buxton, Maine, Mr. Waterman was a member of the United Congregational church, Bridgeport, and a former trustee of the church. Mr. Waterman was a member of the Board of Governors of M.I.T. and its Alumni committee. He was a director of Bridgeport Hospital and a past president of the Fairfield county M.I.T. Alumni Association. Mr. Waterman was a trustee on the board of the People's Savings Bank and was a former member of the Fairfield Republican Town committee. He was also a member of the Stratfield Fire Commission and was active in civic organizations in both Fairfield and Bridgeport. Survivors are his wife, Mrs. Bertha Nickerson Waterman of Fairfield; a son, and three grandchildren.

Will we see you June 1-4 at our 60th Reunion?—**George Philip Capen**, Secretary and Treasurer; **Rosalind R. Capen**, Assistant Secretary; Granite Point Road, Biddeford, Maine 04005

14

If you haven't yet given to the 1973 Alumni Fund, there's still time before the

campaign ends in June. So far, we're doing a bit better than last year; let's make it a lot better.

When an invitation came to an exhibition of paintings by **Alden Waitt**, I asked him for information about it. The catalog and newspaper clippings he kindly sent made it clear again that he has had two very successful careers, in military chemistry and in painting. He served in the army in France in World War I, later received a master's degree from M.I.T., entered the regular army, was Assistant Chief of Chemical Warfare during World War II, and afterward, as a Major General, was Chief of Chemical Corps for four years.

He retired in 1949 after 30 years of service. Alden holds the Distinguished Service Medal, the Legion of Merit, and the Army Commendation Medal with three Oak Leaf Clusters, and is a commander of the Order of the British Empire. Alden took up painting at the age of 65, first as a hobby, and then, as his talent developed, as a professional. His recent exhibition, a five-week, one-man show at the Health Service Center of the University of Texas at San Antonio, consisted of 117 paintings, almost all landscapes, done in Texas, Maine and Portugal. They ranged in size from miniatures to 40 by 28 inches, and in price up into four figures. The review by Glenn Tucker, art critic of the *San Antonio Light*, read in part, "General Waitt's landscapes are the essence of simplicity; their restrained, carefully composed images are never forced, never artificial, never out of aesthetic proportion. He is the least affected painter I know, working on his own whenever he likes, choosing his subjects with care and devotion." A rather slow recovery from surgery late last year kept Alden away from his easel for a couple of months, and then he was faced with the job of finding an angle to supply funds for a new building for the art school of which he has long been an officer. In his letter of early March, Alden describes the coming of spring and indicates that he's painting again. He and Kathryn, who were married in 1917, have lived in San Antonio for the past 20 years.

Early in February, **H. S. Busby** sent clippings with pictures of the results of an ice storm and a following snowstorm in LaGrange, Texas, where he lives. One picture, a snow-covered cactus, could well serve for a Christmas card; another, of a road through woods, looked like a winter scene in New England. Bus mentioned that the two storms stopped traffic for three days.

Charles F. Thompson died at the age of 83 on January 24, 1973, in a hospital near his home in Denver. After attending Dartmouth, he was with us for all four years, graduated in Course III, and was a member of Kappa Kappa Kappa Fraternity. For a few years after graduation he was superintendent of the Logan Mill in Crisman, Colo. In 1917 he went to Tyrone, N.M., as metallurgist with Phelps Dodge Corp. In the early '20s he joined Mine and Smelter Supply Co., in El Paso, Texas; was transferred to Denver in 1936, and remained with that company as a mining and metallurgical engineer until he retired in 1967. He traveled widely in the United States, Mexico and Canada, and had many friends in all three countries. He spoke Spanish fluently, and did translations in his field from French and German. Charles was a member of Masonic Lodge 130, the American Institute of Mining and Metallurgical Engineers, and the Colorado and New Mexico Mining Associations. In 1916 he married the former Cora Ellen Bellows; she died in 1957. He is survived by three daughters, Mrs. Marjorie T. Sutton (to whom I am indebted for most of this note) and Mrs. Ruth T. Hall, both of Denver, and Mrs. Anita T. Horton, of Monticello, Ind.; four grandchildren and two great-grandchildren.

New address: **Harold A. Mayer**, c/o Mr. Mike Murphy, P.O. Box 2331, Salem, Ore. 97308.—**Charles H. Chatfield**, Secretary and Class Agent, 177 Steele Rd., West Hartford, Ct. 06119

15

Christmas cards and messages (you're doing better for the column) continue—**Alice Anderson** was on the *Stella Polaris* for a Caribbean Cruise—how these attractive widows do get around. . . . **Barbara Thomas** sends her thanks and appreciation to classmates who cheered her with their cards and messages. . . . **Larry Bailey** competed with Dave Patton, '16 by falling from a ladder to break his shoulder. He was in the Jordan Hospital at Plymouth and class representatives visited him there and at home. The rest of you take warning—keep off those ladders doing household repairs.

Mona and **Clive Lacy** finally got to Orlando, Fla., for a March visit with their son Bill, '43, who has a citrus grove there. . . . **Ben Neal** has been collaborating with Charlie Diebold, '58, in reviving interest in Alumni functions and M.I.T. activities in their Buffalo area; a very commendable program and success to them in their efforts. . . . **Bob Mitchell** seems to enjoy being a Floridian senior citizen. "Thank you for the photo which you sent. I look a bit more time-worn now, but I'm still functioning fairly well; slowed down a bit, stooped a bit, but got through my 80th Birthday OK.

"We lead a simple life here, on a small lake, on the outskirts of Clearwater. "I have a large garden where I raise vegetables which you would not believe could thrive in such sandy soil. The secret is that our lake is loaded with fish which I can catch by the bushel. Plowed under in the winter, they produce amazing results—corn nine feet high, and as good as any I've raised up north. In the summer we go north to visit our families. I have two grandsons in (Cornell) now, and three granddaughters. One of the grandsons is a whiz at mechanical things. He should have gone to M.I.T.; but he likes the open country; *and* his father is a professor at Cornell. My elder daughter and her husband are both on the Cornell staff. I still drive OK, but avoid long trips where possible, so get to Boston very little. But I do get to Cape Cod every summer. One of my son-in-laws has a summer home there, and my brother also; on Scraggy Neck. This for me is the gateway to Heaven."

After all these years Bee and **Charlie Norton** had their first cruise in February, on the new Cunarder *Ambassador*—good for them. . . . **Larry Quirk** keeps going and recently visited the Hoover Dam, which must have been a real spectacle for a Course I guy, from San Francisco. . . . **Mary Plummer Rice** wrote she was on her way to the annual M.I.T. Fiesta in Mexico City and then to a D.A.R. meeting in Washington. She's wonderful. . . . **Ray Stringfield** writes he has finally retired but is still called on to testify in court cases on fire accidents. . . . Joan and **Bur Swain** are enjoying their retirement with good health in Southern Pines, N.C. I enjoyed a pleasant visit with them two years ago.

Sol Schneider expects to be at our annual Class Cocktail party and dinner here on June 4 and we'll be glad to see him again. . . . Ah, me, that **Jim Tobey** writes from Lake Worth that he is suffering in the 80 degree heat and bright sun with a swim tank in front of his villa. . . . Another sufferer from New England's rugged winter climate—**Bob Warren** in Tuscon planned to see Virginia and **Hank Marion** out there. Bob assumed Fran and I were enjoying our annual winter cruise—paid by my stipend as Class Secretary. Well, well, how did he find out? . . . **Pop Wood** has been shovelling snow in Peterborough, N.H., to train for his spring lawn bowling games on the velvet turf at Randy Spalding's, '22, Spalding Inn Club, Whitefield, N.H. At a pleasant lunch with **Max Woythaler** he shuddered at how we have aged since the pictures of our 35th Reunion.

I've enjoyed an interesting correspondence with Harold Dodge, the perennial hard working '16 Secretary. I think he'd like to organize a Class Secretaries Union. From undergraduate days, he's an old friend and admirer of the Pirate—so, who isn't?

Next month you'll read about the Class Luncheon here at the M.I.T. Faculty Club on April 13. So, until then—help!—**Azel Mack**, Secretary, 100 Memorial Dr., Apt. 26A, Cambridge, Mass.

16

Time soon for our next annual Reunion, the 57th, to be held at the same ever-enjoyable Chatham Bars Inn, Chatham, Cape Cod on Tuesday, Wednesday and Thursday, June 5, 6 and 7; we hope to see you there. This year, for those who can't make the Cape, there will be a Mini-Reunion at Tech on Sunday June 3, 5:00 to 6:00 p.m. as indicated in the recent issues of the *Review*. Just let us know whether you'll be at Chatham, or at the Mini-Reunion, or both.

Instead of starting us off with a bit of philosophy, our always-doing-something President, **Ralph Fletcher**, says he has a word of advice regarding Christmas: "I would seriously advise our classmates to start their Christmas shopping on December 26, each year and have it completed and delivered by Thanksgiving. Then they will have something for which to be thankful on that day and they will

also be able to enjoy Christmas for a good solid month each year. I'm serious about this and I'm going to start doing it right now!" We wonder who'll be the first to call him and ask, "How's it going?"

A recent item in the *Washington Star* and *News*, reporting the death of William Ransom, '97, math professor at Tufts for 50 years, made an interesting reference to Van Bush: "Dr. Ransom was credited with being the first person in the country to introduce the teaching of the slide rule. . . . After two of his former students, **Vannevar Bush** and Norbert Weiner, received the National Medal of Science from President Lyndon Johnson in 1964, Dr. Ransom said he 'knew these two were going far, but never how far because I never dreamed how far science itself would go. I'm afraid they've all left me way behind, but that's the way it should be.' "

From out in California, we hear the **Ken Sullys** of Laguna Hills took a trip in August to Alaska on the S.S. *Monterey*, stopping at Vancouver, Victoria, and San Francisco to visit friends and relatives. Ken writes: "Our wonderful community, Laguna Hills Leisure World, now 15,000 still under development and construction, will ultimately have a population of 21,000. We play shuffleboard and belong to one of the four teams that play in the Orange County League." . . . In replying to one of our old postcards of the Statler, **Paul Austin** of San Francisco tells of his visit to Boston with his wife last year and their stay first at the Statler and then at the Ritz Carlton which they preferred. "To us, the best thing about the Statler is that it has a Trader Vic's restaurant, which we enjoyed and recommend highly no matter where you find one. The home office is in San Francisco and we know Trader Vic and his wife personally. He has superb taste in decorating his restaurants, and sometimes acts as a consultant in the design of new restaurants."

From **Francis Stern** we hear directly, or via Lois and **Charlie Lawrance**, about winter life in Palm Springs. Gladys and Francis have been in sunny land since November where it was warm until the second week in December—then turned cold for Southern California and stayed that way until mid-February. It sounds enervating to hear of their daily walks but the local golf course rule doesn't allow walking while you play and insists on the use of an electric cart. This differs a bit from what we have been used to, say, down at Chathan Bars Inn! . . . **Allen Pettee** indicates that plans are under way for an annual M.I.T. dinner in his Tryon, N.C., initiated by Butler Cooper '29, and including A. F. Norton, '06, John Poteat, '18 and Moss Guilbert, '18. Looking to the future, Allen outlines some interesting plans he and Helen have made. "We have finally decided that while we can move under our own power, we should hole-up somewhere close to an infirmary. So next fall, with a little bit of luck, we shall sell our house here and move to 'Highland Farms' at Black Mountain, N.C. The 60-bed infirmary has been in full operation for a year, and our ground floor apartment along with 59 others is furiously under construction. Black Mountain, at 2400-feet elevation, is in the beautiful Swanannoa Valley, high enough to shut off most good TV reception, so that a hook-up with Cable TV is already in operation." (General Cable, we trust!)

Back in February, we had word from Gyps and **Cy Guething**, who were stopping off for a visit in Savannah after their usual longer stay in Delray Beach, Fla. Cy had much enjoyed, he said, not doing any winter snow shoveling back home in Birmingham, Mich. But this time the weather man was playing games with him, for he had just found himself in the worst snow storm in Savannah in ten years—the papers said 14 inches of the white stuff. "The streets are in bad shape as they have no equipment for cleaning them off." With our total of one seven-inch snowfall in New Jersey this past winter, we reserve comment on whether the South or the North is better in winter for those who don't like to shovel snow! . . . And we've had word from **Este Fisher** of Baltimore who has been a practicing architect from way back since his return from France in World War I. Until 1926, he was with Parker, Thomas and Rice, Baltimore and Boston. In the Baltimore office, he became a partner from 1924 to 1926, and from 1927 to date, has been with Taylor and Fisher, successors. Starting this year, the firm has been known as Taylor, Fisher, Bowersack and Martin, Inc. and he finds himself still plugging along, "swamped with paper work, just giving questionable advice and trying to keep peace in the shop. "We've had a good practice over the years," he continues, "now mostly Telephone Co., over 150 buildings, all sizes. Conservative, don't approve of youngsters' proclivity to try 'their thing' at clients' expense." And he adds his best wishes to all!

We regret to report the death in October of **Samuel Lapham**, a prominent architect of Charleston, S.C. In 1920 he helped establish the architectural firm now known as Simons, Lapham, Mitchell and Small. As indicated in the *Charleston News and Courier*, his firm "was the architect for a number of Lowcountry plantations, Yeamans Hall residences, city residences, churches and parish homes and the U.S. governmental monuments at Parris Island Marine Base and Fort Sumter. Mr. Lapham has been Administrator of a federal survey of historic buildings in the state and past Secretary-Treasurer and past President of the American Institute of Architect's South Carolina Chapter." In the 1920's he spent some time as a professor of engineering at the College of Charleston. His daughter, Ann Lapham Blevins of Spartanburg, mentions some of his recent work as an author and as editor of two books: *Octagon Library of Early American Architecture: Charleston* and *Plantations of the Carolina Lowcountry.*

At the February 1916-17 monthly New York luncheon (now held in the Commodore Hotel on the Thursday following the first Monday of the month—October through June) **Walt Binger** told about a party recently held in his honor on the occasion of his 85th birthday. **Len Stone** reports further on Walt's hobby of riding to hounds. "He was observed at the height of one of the tough jumps blowing his nose. On being kidded about it, he said, 'Why not! The horse was doing the jumping and I had to blow my nose.' " . . . **Nat Warshaw** of Randolph says he is "still going to the office daily to do a morning's work. I just completed the design of a discount warehouse material handling system that has a few new features that have not been tried before. This is the sort of thing that still makes life interesting to me. The total cost exclusive of the building will run about $200,000." . . . We just can't help repeating the words of wisdom on a birthday card we received from **Howard Hands** in Clearwater, Fla.: "Confucius say; He who have birthday—one year older!" . . . **George Crowell** of Brockton writes that he's still active in his general building contracting business, although an eye problem limits his activities a bit. Says: "otherwise everything is OK!"

See you soon in Chatham for the beautiful seashore, delicious meals and another comfortable get-together at our 75th. In the meantime write a little but write often to your trying-to-be-diligent scribes.—**Harold F. Dodge**, Secretary, 96 Briarcliff Rd., Mtn. Lakes, N.J. 07046; and **Leonard Stone**, 34-16 85th St., Jackson Heights, N.Y. 11372

17

The recent question of where our Interim Reunion would be held settled itself readily when the Publick House at Sturbridge wrote that they do not accept groups during October. So make a note on your calendar that we will arrive at the Northfield Inn on Wednesday, October 10 and leave on Friday, October 12. You will receive further information. The Inn is a delightful place. The foliage will be at its peak and a good turn out is expected.

There is rather a double take this month on Helen and **Jack Wood**. First there was a letter and then they made a visit back East. The occasion of the visit was an invitation to Jack from the New England Intercollegiate Sailing Association to be its guest at their 25th anniversary celebration. As is well known Jack fathered collegiate sailing and is a well known and popular yachtsman. The Lunns and the Dunnings attended the anniversary dinner held at Tufts University for some 200 sailing-minded people including a large contingent of men from the Coast Guard Academy at New London where Jack was once on the staff. Many sailing trophies were awarded with numerous New England colleges being represented. Fittingly M.I.T. walked off with by far the largest number of trophies with several going to the M.I.T. women sailors. Jack gave an interesting talk and showed a film of early M.I.T. sailing. The following Monday Al Lunn had Jack as his guest at an Alumni Advisory Council meeting when Jack met many of his old friends, including Stan Lane, and former colleagues. The letter referred to above was quite another story for it tells of their San

Diego activities. Not surprisingly they have bought "a sweet little boat—a Tarton 26. Jack was so busy all summer that we hardly had a chance to use her. Since then we have cruised her to Catalina Island, when she proved her weatherly qualities crossing the channel in a 35 knot Santa Ana. As we plunged through the ten-foot chop sending sheets of spray up to the spreaders I shouted to Jack 'This is the worst I've ever been through'. He just said, 'You're lucky.'" It was a treat to see them again with both looking so well. One could not but think how good it is that a man could find such satisfaction and happiness in his chief, natural interest and to be able to carry on so well complemented by a capable wife.

Dud Bell's acupuncture treatments have been delayed so there is no further news except that since his first treatment warmth returns to his feet and ankles. . . . **John DeBell** supplied a '17 *Technique* picture of the Chemical Department personnel, taken at Walker Building, to the department memorabilia. . . . **Elmer Joslin** was off to Florida and **Frank Peacock** was getting down to Sarasota. . . . **Brick Dunham** will attend his sixtieth reunion at Andover Academy this June. . . . **Tom Meloy** was seen recently lunching at the Faculty Club with President Wiesner and Chancellor Rosenblith. . . . The latest word of the **Bill Hunters** had them dancing out the old year at The Tavern in Montpelier, Vt. They were visiting their daughter's family too.

Take note! On Sunday, June 3, "Mini-reunions" will be held for returning classes to the Alumni Day events. Our plans are not complete but '17 will be posted with other groups so be alert to find us before the buffet and the Pops.

With regret the death is announced of **James P. Ferrall** at Geneva, Ill., on December 22 after a heart seizure.—**Stanley C. Dunning**, Secretary, 6 Jason St., Arlington, Mass., 02174; **Richard O. Loengard**, Assistant Secretary, 21 East 87th St., New York, N.Y. 10018

18

As your roving representative in the Boston environs, I occasionally visit our Alma Mater to report on new activities. Recently, I visited a new course for freshmen called, "Concourse." The format is a group of 30 to 40 students who take all their classes together. A team of instructors participate in the general sessions independent of their particular discipline for that morning, (physics, chemistry, or what have you). I found the students bright and attentive, the atmosphere was quite informal. I was not favorably impressed when a student drank a coke, ate an apple or a piece of pie.

Strange to relate, I understood most of the lecture on "Optics", despite being out over 50 years. It seemed to me that the combination of professors from various disciplines and students studying a problem together, was a stimulating experience. Nevertheless, I still feel that putting your best foot forward and having a neat appearance is an asset not to be ignored.

A special vote of thanks is due our genial and faithful Assistant Secretary, **Len Levine**, for the following five newsy notes from classmates. He went to work with his mighty pen with a diligence which I hope many of you will emulate.

Edward W. Gore, who some of you may remember, transferred from Tufts, having graduated there in '16. He writes, "I was in that group who went into service in '17 and spent nearly two years in Artillery as a 'Shavetail' in France. Returning in '19, I graduated with the Class of '20. My checkered career was generally in manufacturing, with some consulting work, and even ten years in the Air Force as an Industrial Engineer trying to control costs!

I retired in '65 and we moved to Old Lyme in '66, the scene of pleasant times of our youth. I wasn't smart enough to teach, so got involved in small town politics and other unrewarding activities. I have a son, Class of '55, in Course XV, doing quite nicely in I.B.M. World Trade Group. He and two daughters are responsible for 11 grandchildren, who help to keep me going. I haven't been back to the Institute since WWII when I was involved with Sperry and Charles Draper."

Harold L. Miller writes, "I have lost touch with most of my classmates and would welcome hearing from any of them. You said that you were teaching at a Boston Jr. College. Perhaps, instead of writing about myself, I could drop in at the college some time and have a chat with you." . . . **Robert C. Heyl** writes, "As you may know, I graduated from Princeton in 1916 with A.B. and decided I wanted to be an engineer so I enrolled at M.I.T. With my credits, I was supposed to take three years at M.I.T. for a B.S. in Electrical Engineering. When 1917 came along and war was declared, I took some summer courses and applied for the Officers Training Course at Camp Upton, L.I. M.I.T. granted me a B.S. degree, counting the O.T.S. as my thesis. I was sent to France in March of 1918 and was commissioned as a second lieutenant in the Artillery. After the Armistice, my outfit, an anti-aircraft battery protecting G.H.Q. at Charmont, had orders to return immediately and I got back before Christmas 1918.

"As a native of Philadelphia, I had a job with the I.T.E. Circuit Breaker Co., and was in charge of their New York office for 15 years. After that, I joined B. W. Cramer Co., in Centerbrook, Conn. Again I was in charge of the *New York* office. My wife and I lived in Pelham Manor for 20 years and then returned to North Carolina. I lost my wife to cancer in 1969 as we were about to celebrate our 50th wedding anniversary." . . . **Leslie A. Stewart** wrote to Len, "Forty-two years ago I came to the conclusion that I would rather be in business for myself instead of being bounced around in the engineering field; hence I turned to the life insurance business (Northwestern Mutual), and during the past 30 years my entire interest has been in the direction of a pension and profit sharing consultant calling on industry within 130 mile radius. In fact, I am still pursuing this field at a ripe age, and believe it or not enjoying it; however, I have cut my radius to 60-70 miles, or should I say I have been slowing up! "I am pretty well acquainted with Boston. My wife and daughter are graduates of Wellesley and her husband Russell Cox graduated from Harvard, with Harvard Business School directly after. My other daughter, age 37, is a graduate of Wheelock College and her husband is a graduate of Harvard and they are domiciled in Pittsburgh. My daughter and her husband in Boston have three girls, however, they had a very sad experience last August when a cyclone hit the Longwood Tennis Club and my 14-year old granddaughter was killed."

A post card from **Tom Brosnahan** in February from Innsbruck, Austria, notes that all cows in that country must wear bells—their horns don't blow!

Faithful **Mal Baber** sends me this note: "Sorry we had to miss the Mini-Reunion last fall. Unfortunately, we had to be in Philadelphia that Saturday and it was too difficult to fly up late that night. In consequence, our little trip to New England just took us to the edge of Massachusetts, just over the border from Winstead, Conn.

"At this moment, I am home after a short stay in the hospital following a heart attack, minor in magnitude. Hope to get off to Hilton Head for several weeks soon. I have every expectation of getting to the Reunion this June. Am still working as well and as much as my limited capacity permits. I hope to continue but retirement looks more and more inviting."

By this time, you will have received notices of our 55th Reunion June 1 to 4 at Chatham Bars Inn and in Cambridge. We are hopeful that you will all make a special effort to be with us at this occasion. I hope that the writers of the letters in this issue will make a special effort to come so we can meet and greet you.

Our latest information from the Alumni Office gives the following new addresses: **Walter T. Biggar** to Box 1225, Jensen Beach, Fla. 33457 and **Joseph A. Kelley**, P.O. Box 547, Anna Maria, Fla. 33501—**Max Seltzer**, Secretary, 60 Longwood Ave., Brookline, Mass., **Leonard Levine**, Assistant Secretary, 519 Washington St., Brookline, Mass.

19

A card came from **Nelson Bond** dated March from Swiss Tunisia. He had dinner with Elizabeth and Julian Howe in February.

Word was received from the Alumni Records of the death of **Francis T. Coleman**, S. Dartmouth, Mass., on November 20, 1972; and of the death of **Richard H. Combs**, Brainerd, Minn., on December 11, 1972. A note from Mrs. Gladys A. Coombs states he passed away suddenly.

Margaret and **Marshall Balfour** wrote from Chapel Hill after their trip to Florida and Delray Beach. "Health wise we are doing reasonably well, considering that both of us have passed the 75th milestone. Medical and surgical consultations have become more frequent and we have reason to be thankful for Medicare benefits."

"We still find Chapel Hill, N.C., a satisfying spot, climatically, culturally, and ecologically, for home and retirement.

Aside from giving an occasional lecture in the University of North Carolina School of Public Health, Bal is a keen member of one of Chapel Hill's five "men's conversation groups" for retirees, which meets bi-weekly. A weekly session of horseshoe pitching with a group of neighbors is a form of exercise and competition. Aside from housework, Margaret's interests include native plants and trees, walks and talks."

"As for travel we had an enjoyable four weeks in Greece during the summer. After flying with a group we made a Hertz drive-it-yourself trip from Athens to Salonica, a five-day island cruise and a bus tour to classical points. Of our six grandchildren, three are in college now—Western Reserve, Swarthmore and the University of Maryland. It was grand seeing you in Delray Beach and enjoying your hospitality."

Barbara and **Don Way** had lunch with the Smoleys in January while they were visiting her brother. They are both fine and have a son in college. Plans are being started for our 55th Reunion in 1974.

Your Secretary had an eighth grandchild—a second grandson, on February 15, one day shy of my wife's birthday, in Portland, Maine—Steven Forest Hodgkin. Your Secretary finds the golf and ocean swimming excellent here this season and wishes the Class the best for the summer. More news would be welcome.—**E. R. Smoley**, Secretary, 50 East Rd., Delray Beach, Fla. 33444

20

Congratulations are in order for our popular classmate, **Frank Maconi**, on the occasion of his marriage to Mrs. Colesta Headley. Frank has moved from Framingham to Leominster, Mass., address 33 Bonnydale Rd., and has been reconstructing a country store in the basement there to house his collection of early American country store antiques containing over a thousand items. Frank will also have to reconstruct his famous flower garden. Says he, "by early March my 'store' will be ready to receive any '20 visitors."

A note from **Foster Doane** tells of his plans to go with Gladys on the M.I.T. trip to Denmark. . . . He mentions a very pleasant five weeks earlier in the winter with Winnie and **Frank Badger** in Hollywood Beach, Fla. . . . Welcome word from **George Morgan** of Beaumont, Texas, to say that he is in good health and "able to get around." . . . Evelyn and **Don Kimball** have been spending the winter at Seagate Hotel and Beach Club in Delray Beach before returning to their Rochester house. . . . **Gerry Tattersfield's** latest address is 201 W. Evergreen Ave., Philadelphia. . . . **Jim Wolfson's** is 300 Diplomat Parkway, Hallandale, Fla. . . . **Fred Fischer's** is A.P.M. Co., P.O. Box 484, Kalamazoo, Mich.

In a recent issue I mentioned **Buzz Burroughs'** prowess as a prominent member of the Winchester Country Club curling team. This is confirmed by his team's victory at White Plains, N.Y., to become Douglas Medal champion. The report from the St. Andrews Golf Club's vintage bonspiel is that Buzz "swept as vigorously as a man 40 years younger." . . . It is pleasing to learn of the promotion of a son of one of our distinguished classmates, **Malcolm B. Lees** of Ridgewood, N.J. Nelson Lees has been appointed Director of Resource Planning in the M.I.T. Development Organization Nelson has long served the Institute with distinction as Director of the Development Office. His new duties will be principally concerned with direct support of the senior Institute officers and development staff. He will also serve as Secretary of the Council on Resources. He has been editor of the M.I.T. *Observer* and has acted as host on the M.I.T. Science Reporter for WGBH-TV.

With a heavy heart I have to report the death of our beloved classmate, Dr. **Carl Leander**, founder and Director of the Golden Rule Bible Classes in Quincy, Mass. Carl was a lifelong resident of Quincy. He received a master's degree from Harvard and in 1947, St. Augustine College in Florida awarded him a doctorate of laws for his work on the Bible and the social sciences. He developed the Golden Rule Bible Classes nearly 50 years ago. He served for several years as an at-large Quincy Councilman and was Past President of the Massachusetts and Northern New England Youth Council for the Covenant Congregational Church. He leaves his widow, Alice, a daughter and six grandchildren. His home was at 44 Common St., Braintree, Mass.—**Harold Bugbee**, Secretary, 21 Everell Rd., Winchester, Mass. 01890

21

A letter from Richard Knight, Associate Secretary of the Alumni Association, announced plans to hold Mini-Reunions on campus at 5 p.m., Sunday, June 3, just before the International Buffet and Boston Pops. A number of our classmates and wives are planning to come and get a convivial start on the Alumni Day events. Come join us!

Your Secretary goofed! In the January Class Notes, telling of a delightful visit last October with the Cape Codders, it was reported that Millie and **Don McGuire's** son was engaged in a study of the possibilities of putting a large telescope in orbit around the earth. The telescope part was OK but it was the wrong family—it was Hazel and **Whitney Wetherell's** son Bill who was involved. My apologies. Bill attended the University of Rochester and his proud parents wrote that he graduated with honors, earning a master's degree in optics in 1961. Further news of the Wetherells is that Whit was persuaded to run for a one-year term on the Harwich Park and Recreation Board. They are a family of many activities.

The first issue of the News Letter of the Council for the Arts at M.I.T. was of particular interest to the Class of 1921 because of the membership on associated committees of Assistant Secretary, **Samuel Lunden**, and Nelson C. Lees, '53, son of our deceased classmate, **Cornelia Nelson Lees**. As we all know, interest in the Arts has grown substantially at M.I.T. in recent years and is now an integral part of an M.I.T. education.

Ted Spitz of Roslindale, Mass., reports his working as construction engineer for Mario Susi and Sons last summer and fall. The work involved highway and associated construction in the South Cove area of Boston and was part of the Boston redevelopment program.

Class photographer **Robert Miller** and **Laurence Buckner** are continuing to work assembling and enlarging the photographic montage put together by Buckner a few months ago. Plans are afoot to add two more rows of classmates and wives' pictures, and letters have gone out to additional couples attending our 50th reunion who didn't happen to get snapped. Please send in your pictures to Bob Miller.

Betty and **Sumner Hayward** recently had the pleasure of a luncheon date with Dorothy and **Joe Wenick** and their son Martin, who is Second Secretary and Political Attaché at the American Embassy in Moscow. Although he did not talk in Russian which he speaks fluently, Martin told most interestingly of life in Moscow, travel limitations for embassy officials, prices and availability of different foods, clothing, automobiles *et al*, and the Russian people.

Assistant Secretary **Josh Crosby** sent along a welcome letter from **Ralph Wallace** of Deltona, Fla. Ralph retired from the New England Telephone Company in 1960 as General Traffic Engineer and now divides his time between Maine and Florida. His older son Robert graduated from Worcester Polytech and now works for the F.C.C. in Washington. His younger son Frederic with degrees from Harvard, Caltech, and Tufts is a physical chemist with Polaroid. Ralph plays golf about every day and writes that he sees Hobart Fischer, '22, quite often.

Our Ohio correspondent, **Wallace Adams**, has taken on a new job. In addition to a lot of church work, Wally recently became Vice President of the Ohio Engineers Foundation, the non-profit adjunct of the Ohio Society of Professional Engineers, responsible for donations, scholarships grants, continuing education, and the operation of the Engineering Center in Columbus, Ohio. On the fun side, Wally plays golf at every opportunity and has made plans for an early spring trip to Palestine, Athens, and Rome. The rector of his church will be the tour escort and a series of lectures during Lent provided background history of the Holy Land.

Sadly, we report the death of two of our classmates: **Edward W. Noyes** of Nokomis, Fla, and **Everett J. Wilson** of Temple, N.Y. Coincidentally, both of these men were born in Newburyport, Mass., and only about a month apart. Ed Noyes served in both World Wars—an army man in the first and a lieutenant commander in the navy in the second. In retirement, he and his wife Kay divided their time between Florida and a summer place on Coxton Lake, Pa. Ev Wilson was always active in civic, church, and Masonic affairs, serving as a selectman, library board member, and board chairman of The Temple Trust Funds. Happily, Ev and Sarah Wilson were with us at

the 50th Reunion. The sympathy of the Class is extended to their families.

A flash report just received from **Josh Crosby** provides news of the interim Mini-Reunion held at the Bardmoor Country Club in Largo, Fla. on March 11 and 12. The affair started with cocktails at the beautiful home of **Oliver Bardes**, followed by a delicious prime rib dinner at the country club. A note of sadness was present because Ollie was taken ill in Cincinnati a week before the reunion, so that he and his wife Olive were unable to attend. However, Ollie insisted the party be held and his sister, Mrs. Richard Roe, acted as gracious hostess at cocktails and dinner. A letter and a silver tea set were sent to Ollie in gratitude for his generosity and with wishes for his complete recovery. At dinner that Sunday night, besides the hostess Lucille Roe, were Allen Addicks, Becky and Elmer Campbell, Mildred and Tom Bartran, Josh Crosby, Kay and Ed Delany, Olive and Herb Gwynn, Ruth and Irv Jakobson, Emma and Al Lloyd, Muriel and Vic Phaneuf, Graciela and Helier Rodriguez, Helen St. Laurent, Ida and Roy Snyder, and Win and Royal Wood.

Reports are that everyone present considered this a delightful affair. **Al Lloyd**, Interim Reunion Chairman, announced the plans for the 55th Reunion in 1976 at Portsmouth, N.H. He and Josh Crosby took numerous pictures of those attending to add to the class records. The next day plans were made for different groups to visit the Sunken Gardens and the Aquarium in St. Petersburg and the good ship Bounty. The Jakobson Shipyard rebuilt the interior of the Bounty after the completion of filming for the movie, restoring it to a facsimile of the original ship commanded by Captain Bligh. The movie ship during filming was equipped with luxury cabins for the movie people.

Monday night of Reunion, the group had dinner at the Bath Club on the Gulf (Tom Bartram and Elmer Campbell are members) and Al Lloyd showed some of his slides. The Florida Reunion Committee deserves a lot of thanks for the many hours of work and planning that made this a successful reunion.

Other Florida news items: Alice and **Bob Felsenthal** of Westport, Conn., are staying in Sarasota near their close friends, Millie and **Herb Kaufmann**. Bob is convalescing from illness and the Class wishes him a speedy recovery. . . . **Dick Spitz** of Longboat Key broke into print with a letter to the *Sarasota Herald-Tribune* taking issue with Professor George Cabot Lodge of the Harvard Business School and his theories about property ownership. . . . **Josh Crosby** reports attending a luncheon meeting of the M.I.T. Club of Southwest Florida at which Roy Ellis, '22, was speaker. "An excellent meeting," said Josh, "and it was nice to have classmates **Larc Randall**, **Herb Kaufmann**, **Roy Wood**, and **Whittier Spaulding** as luncheon companions."—**Sumner Hayward**, Secretary, 224 Richards Rd., Ridgewood, N.J. 07450; **Josiah D. Crosby**, Assistant Secretary for Florida, 3310 Sheffield Cir., Sarasota, Fla., 33580; **Samuel E. Lunden**, Assistant Secretary for California, Lunden and Johnson, 453 South Spring St., Los Angeles, Calif. 90013

22

Buffalo has not run out of its beautiful warm, nonskiing weather. We apologize to those in Florida for not calling, but our schedule while there was really hectic. The golf was great! . . . Madeline and **Parke Appel** have become sold on the advantages of life in Florida in escaping "cold weather, confiscatory state income taxes, real estate taxes, extra sales taxes, excise taxes and inheritance taxes in Massachusetts." Parke says it costs less and they are enjoying it more even including apartment living. He is now President of their condominium corporation and has joined the Elks and St. Marks Episcopal Church in Venice, Fla. They have called on the **John Starkweathers** in Venice East at their lovely home close to the golf course. They have seen **Doc Marvin** and Cora at Ft. Myers and their development of exotic flowers and shrubs as expert horticulturists. Madeline and Parke will return to Dover during April to sell their country home and most of the furniture in making their move south to the sun coast. Parke enclosed a clipping of the Class of '22 Career Development Award to Dr. Margaret L. A. MacVicar, M.I.T. Assistant Professor of Physics as announced in February by Paul E. Gray, Chancellor, and Walter A. Rosenblith, Provost. This is the '22 Fund announced at our 5t0h Reunion to be used to sharpen and supplement the capabilities of deserving members of the faculty in the development of excellence in teaching. In making the announcement of Professor MacVicar's new appointment, Dr. Gray said "It is particularly fitting that this award—growing out of the generosity and farsighted devotion to education of the Class of 1922 which has for so long expressed its concern for undergraduate education—go first to Professor MacVicar, who embodies a spirit of renewal and vitality that is critically important to the Institute at this time in history."

A welcome note from **Frank Kurtz** in Delray Beach explained that he was playing tennis when we called him in February. He included a clipping telling of their first prize in Florida's 2¢ Lottery—being one week in Buffalo with second prize as two weeks in you know where. (Not funny!). Carlys and Frank will take the North Cape cruise in June on *the Kungsholm*. The **Ab Johnsons** will be with them. . . . **John S. Williams** has recently returned from a Virginia Museum Group trip to Sicily, Greece and the Greek islands. He found Athens greatly changed from a sleepy small town of the 1920's to a busy, exciting, prosperous metropolis, in which it is safe to walk around by day or night. He is now back to insurance and tennis but is still a widower. Any suggestions would be appreciated! . . . Dr. **John W. Strieder** of Chestnut Hill still is enjoying the thrill of the 50th Reunion thanks to the efforts of Appel, Spoor and company. . . . **James M. Waechter** of Hollywood, Fla., wrote us of his experience in selling equipment to eliminate black smoke from stacks, working as an industrial engineer in charge of time study, rate setting and general operations in the steel industry. He is also in the consulting field for the paper board and carton industries for surveys including all phases of the operation for improvement and substantial reduction in cost. He has advised on plant facilities, operation processes, production methods, warehousing and material handling with headquarters in Cleveland. His present address is in Hollywood, Fla., indicating a time of relaxation.

We received pictures and clippings of **Ray C. Ellis** in the limelight around Sarasota in senior citizen activities, A.A.R.P. and the Tech Club of Sarasota. He presented a series of slide lectures on Russia for the Sarasota Institute of Lifetime Learning. While in Washington, D.C. last fall he helped conduct a seminar on East/West trade. His latest slide lecture was entiteld "An Evening at the Hermitage" Russia's great museum in Leningrad. In his early years he was affiliated with General Motors and joined Charles Wilson and Knudsen on the War Production Board. He also worked with Ambassadors Harriman and Thompson and was involved in moving and re-establishing an electronic parts factory from Leningrad to Novosebirsk, Siberia. In 1945 he joined Raytheon Co., and in 1957 served as Chairman on the exchange mission to Russia. He was a member of the Government's first trade mission to Finland in 1961. He co-authored a book on foreign trade *Export or Die* and has conducted industrial productivity studies in several foreign countries. He still takes a keen interest in world affairs and keeps current, particularly in trade relations with Russia. The U.S. needs his knowledge right now.

The Alumni Association has picked up the idea which the Class of '22 has had for years—that of running Mini-Reunions. This is a great concept and made better by their arrangements to be made for rooms, bar service and snacks. A minimum of 30 persons will support a private bar—smaller attendance allows a combination with other classes for the same convenience. Let's try them out! . . . **Raymond E. Miskelly** has temporarily moved from Plymouth to Siesta Key along the west coast of Florida. . . . **Charles C. Comey** is preparing for a 50th wedding anniversary next January. We all wish this happy couple many more constructive years. . . . When we start to check up on **Horace W. McCurdy** of Seattle, the sky seems to be the limit! Mac's retirement from active Scottish Rite service was a very special night for the Valley of Seattle last fall. Over 300 Brethren met in a decorated Temple recalling the McCurdy ancestral home on the Isle of Bute. The unique program opened with the shrill call of bagpipes and continued with familiar Scottish airs as other illustrious brothers praised the guest of honor, a thirty-third degree Mason. Catharine was on hand to help with the congratulations as was their son James G. McCurdy, Board Chairman of Lockheed Shipbuilding and Construction Co. We received the February issue of the *Port of Seattle Reporter* showing Mac's pic-

ture super-imposed over an air view of the vast shipyard complex he directed for 33 years. The seven-page lead article shows pictures of a part of Mac's Marine Library and of airports and ships constructed under his guidance. We are all happy to join in the cheers for Catharine and Mac McCurdy.

We are sorry to report the loss of our classmate **Hyman L. Rosengard** of Waban. He owned and operated the Fritz Construction Co., of Boston for more than 40 years and was active in many organizations. Our sympathy goes to his widow Helen, his daughter Natalie and his son Donald, all living in the Boston area. . . . The sympathy of his many friends in the Class is extended to the family of **Winslow C. Morse** of San Diego. We received this information from his son Donald of Wellesley Hills and from several of his friends. . . . We also extend our sympathy to the family of **George W. King** of Jackson, Mich. His daughter wrote that he passed away in January.

Walter M. Saunders informed us that the Buffalo weather is about the same as Cape Elizabeth, Me., with no snow to bother his surfing with water at a balmy 35 degrees. . . . Among the changes of address are: Professor Edmund D. Ayers, Palo Alto, Calif.; F. Marion Banks, San Marcos, Ga.; Fredrick J. Burt, Colorado Springs, Col.; Mansell S. Richards, Houston, Tex.; Kenneth R. Sutherland, Wellesley, Mass.; Frederick W. Wiegand, San Antonio, Tex.

You are now picking May flowers, so fill a basket to bring to our Mini-Reunion at the Institute in June. That is the week your Secretary hopes to be returning from Moscow with caviar for all and friendly greetings from the Smirnoffs.—**Whitworth Ferguson**, Secretary, 333 Ellicott St., Buffalo, N.Y. 14203; **Oscar Horovitz**, Assistant Secretary, 3001 South Course Dr., Apt. 103, Pompano Beach, Fla. 33060

23

By the time you read this we should have well over 100 classmates and their wives (or husbands) registered for our great 50th Reunion. You have all received three mailings at least, announcing this event, so it is needless to repeat that coverage except to again extend to all of you our cordial invitation to attend. While it is not essential to stay at the Marriott Motor Hotel in Newton we urge that you register with us and take part in the various events (including bus transport to the Institute from the Marriott) from Thursday p.m. to Sunday afternoon. The "Alumni Days" events begin with buffet dinner on Sunday evening and go through the final reception on Monday June 4 at the DuPont gym in the late afternoon. These latter events require registering with the Alumni Association (see their March mailing). We are all looking forward to a "bang up" good time!

From Cleveland we learn of the trials of **Orr N. Stewart** who experienced an attempted robbery in his department store on E. 93rd St., last January. While "Bolo" was handing over money from his pockets with "a Luger against his stomach" and preparing to go to the cash register as ordered, one of his lady employees slipped around the hold-up man and with her gun in hand ordered the robber to drop his. In the ensuing scuffle both this employee and another lady, who also had reached her gun, shot and wounded the robber, foiling the hold-up. We admire the feminine pioneer spirit in Cleveland—maybe we should go further with this "Women's Lib" business.

Herman A. Bruson writes "I retired at 65 from Olin Corp., in 1966. Now consult for U.S. and foreign chemical companies in Japan, Europe. etc. . . . Just returned from African safari with Virginia. Got shot at in Tanzania. Car demolished but we were not hit. One daughter (Barbara) lives in Bangkok. Her husband is with the U.S. Embassy in Thailand." . . . From **William Glendinning** we see "I am still active in publishing books covering professional engineer examinations and solutions to the problems. They sell all over the country now since most states now give the examinations provided by the National Council of Engineering Examiners, for which my books have been found most helpful."

From **Lester Bridaham** we learn that the book of photographs entitled *New Orleans and the Bayou Country* by George F. Mugnier, with text by Les (himself) has now reached the bookstores. Published by Barre Publishers of Barre, Mass., it is an outstanding work of famous photographer Mugnier during the period 1880-1910. This is another one of Bridaham's fine books of photos (see *Technology Review* Class Review for July-August 1970 for notice of his books on Gargoyles and Chimères). . . . *Now, also, we have word that* **Arthur W. Davenport's** A Great History of the Great Class of 1923, *while it is selling slowly but surely, needs a real push to get it past the break-even point.* It is indeed a fine unselfish effort of great magnitude that has taken over two years of Dave's time—with over 1000 biographies (including your own.) Please send your check for $27.50 (to the order of the Massachusetts Institute of Technology) to A. W. Davenport, P.O. Box 574 Virginia Beach, Va., 23451. You will not regret it. So far, practically all of the financing has come from Dave's pocket, a not inconsiderable sum.

The Alumni Association shows some 60 address changes of our classmates. This is much too long a list to publish here so if you are having "mail return—address-unknown" troubles with the U.S. Postal Service, try me and maybe I can help with the needed info.

We have a newspaper clipping concerning the passing of **William F. McNary** of Cape Elizabeth, Me., on February 3, 1973. "Mac" was a native of Attleboro, Mass., and graduated in our class in Naval Architecture. In his carreer he designed and supervised the construction of yachts, fishing vessels and work boats for which he had a wide reputation in New York and Boston. He was also a field representative for the Caterpillar Tractor Co., and also served as engine consultant for the Arnold Machine Co., the Maine Caterpillar dealer. . . . We have also learned of the passing of Rear Admiral **Lucien M. Grant** on October 3, 1971 and have corresponded with Mrs. Grant. . . . Also we learn that Professor **Jose C. Bertino** of Buenos Aires, Argentina died on June 11, 1972 and **Henry F. Culver** of Hinsdale, Ill., on August 15, 1972. On these last two we have no up-to-date particulars. One more final word—give Davenport a break and order one of his great class histories (see foregoing text and his announcement sent to all classmates.—**Thomas E. Rounds**, Secretary-Treasurer, 4 Deer Hill Dr., Danbury, Ct., 06810

24

Friends, Roamers and Country-Livers, your scribe begins his Notes March 4 in coronary cardiac unit of St. Mary's Hospital, Tuscon, Ariz. A two-month vacation begun on February 6 dashed the ninth by an E.K.G. routing him into the intensive care unit for a week. If you have NOT read my previous medical dissertation, please abandon your multi-floor domiciles for the level road-bed stressed in Civil Engineering. I do not build or sell condominiums, but I now own one in Brookline, which is Uncle Sam's generous way of assisting the elderly homeseeker in reducing his capital gains tax.

I regret that information coming to me indicates that Father Time has placed a heavy hand on members. If I were in Brookline, more background could be supplied on them, but here is what I have received. . . . **Norman A. Evans**, 185 Devonshire St., Boston, Mass., 02110, died November 23, 1972. A Remembrance card in memory of **John J. Grabfield**, December 10, 1902—7 December 1972, quotes a passage on "Comfort" by William Cullen Bryant. . . . On January 12, 1973, the Alumni Office received the following, postmarked Olympia, Wash., "My beloved **Holland Houston** died September 24, 1972. His death was very sudden and most unexpected. Sincerely, Mrs. Holland Houston." . . . E. V. Martin, Course II, writes, "I am sorry to report the death of **George H. Smith**, Course II, aged 75, at Sarasota, Fla., on January 18, 1973. George retired from Union Carbide several years ago and had been living in Florida. Over 30 patents assigned to Union Carbide were held in his name." . . . And finally, Dr. **Norris Johnston**, Box 852, Ojor, Calif., 93023, on notice to the Alumni Association from Mrs. Hinda Johnston, on December 19, 1972. To all the bereaved and loved ones, we extend our deep sympathy.

On the more cheerful side come the exploits of our Class Treasurer, **G. Raymond** (Marco Polo) **Lehrer** and Dorothy. Starting from Florida on February 3, they headed for South America. Most of the places I can not pronounce and will believe they exist when Ray stages his popular, selected-audience photographic production. However, his very well-written travelogue is available upon request and recommended by this reviewer. As these Notes go to press, word comes from Ray that he and Dot will arrive in Tucson, Ariz., on March 19. That will be a big lift for me on my recuperative trail.

Also arriving, just under the wire, a greatly appreciated "Get Well" card from **Paul Cardinal**. He, Lorene, Dot and Ray

Lehrer flew to the Mexico Fiesta together. . . . **John B. Lewis** advises that he is a financial consultant on acquisitions and mergers; market and attitude studies and private placement. Unfortunately, no location appears on his envelope.

Here's hoping that my next effort originates in Brookline instead of Arizona, the land of the saguaro, palo verde, cactus wren and copper.—**Russell W. Ambach**, Secretary, 216 St. Paul St., Brookline, Mass. 02146

25

I had an opportunity the other evening to attend a very interesting meeting at the President's House for an informal time with Dr. Wiesner. The other members of our Class there were **Ed Kussmaul**, **Jim Howard**, **Sam Spiker** and **Courtenay Worthington**. As a result of Dr. Wiesner's talk and the question period we learned a great deal about how things are progressing at M.I.T. today. I believe we all felt that progress was being made under good hands.

Last year I reported an award made to Dr. **Yu H. Ku**. Thanks to Sam Spiker, I have more information to report. Dr. Ku is now retired as Emeritus Professor at the University of Pennsylvania and received an Honorary Doctor of Laws degree at the commencement in May, 1972. The citation reads as follows: "As scholar and teacher, as scientist, administrator, and as poet, Yu Hsiu Ku has revealed many faces to those who have listened, read, and learned from him, each time exhibiting an aspect of a man who has harmonized many gifts into unparalleled achievement. Generous, patient and modest, he served his native China as Dean of two engineering schools, as the President of two universities, as Vice Minister of Education, and as a proponent of major technical initiatives.

Upon his return to the United States after the events of 1949 he made a superb intellectual transition from administration to engineering problems, with major results in the generalized theory of electrical machines and in analytical and graphical methods for the solution of non-linear circuits and control systems. His elegant poetry is loved, as his gentle songs are sung, by his people. The caliber of his students eloquently speaks of his devotion to education and ability to inspire others to high purpose. The Trustees of his University join in his praises by awarding him the honorary degree, Doctor of Laws."

Like many others I sometimes wonder about what happens to our mails. In early March I received a Christmas card from **Masaru Kametani**. This is duly acknowledged.

I am sorry to report the passing of **Mr. Henry T. Walters** of Derby, Conn., on April 28, 1972. Mrs. Walters when at Tech was Dorothy B. Conway.

F. Graham Cunningham of Freedom, N.H., passed away on January 30, 1973. From his widow I have received the following information about Gray. During his professional years he was employed chiefly as a gas engineer with the Lynn Gas and Electric Co., E.I. du Pont de Nemours, the Heyden Chemical Corp., and Ebasco Services, Inc., from which he took an early retirement in 1964.

He was active in his private consulting business in Freedom, was a member of a number of professional societies and a registered professional engineer in New York and New Hampshire. He was a Mason and active in community affairs in Freedom at the time of his death. No formal service was held but there will be a memorial service this summer at his Freedom home, Windfall Farm. He is survived by his widow, the former Margaret Kowalewski, and by two daughters, five grandchildren and a sister.—**E. Willard Gardiner** (Will), Secretary, 53 Foster St., Cambridge, Mass. 02138

26

After a snowless, iceless, cold, windy winter we have been having rain and rough seas here at Pigeon Cove. The storms are always from the east—usually northeast or "nor" east in the local dialect. As you know, the entire east side of our house is glass and the sights can be spectacular, but during the height of a storm it is often difficult to see very much due to spindrift, spray and just heavy downpour.

Last week we had guests coming for lunch on Friday and it stormed all week but started to clear Friday morning. The glass was so coated with salt that it took three hosings with brush and detergent to keep it clean until noon but with the sun coming on strong in the late morning it paid off. The sea remained wild and spurted high as it hit the rocky shore as far as one could see North to South and boiled madly east to the horizon. It was a spectacular view to be able to present to our guests. Wish all of you could have been here to enjoy it with us. But you are here to enjoy our guest of the month, classmate and bachelor **Giles E. Hopkins**. "Hoppie" has written such an interesting commentary that it will permit of no editing, condensing, or even changes in puncuation!

"Dear George: Your reference to me in the January issue smoked me out. Yes, I am still footloose—still living at the New York Athletic Club these 30 years. I did, about ten years ago, move from the south end of the twentieth floor to the the north end when the installation of air conditioning messed up the south end of the corridor. Once there I was too lazy to move back until the need for a paint job made the move south less onerous than letting them in to paint.

"I retired once in 1960, but got itchy feet and took on a part-time teaching job at the Fashion Institute of Technology—not draping and art work but teaching textile basics that everyone should know. Ten years in tying together fiber properties with fabric performance was a good background for that.

"At first I took on four hours per week and, knowing nothing about teaching, probably developed an image between a curmudgeon and Mr. Chips. It was a real shock to haul out of bed for a nine o'clock and face 25 wide-awake 18-year-old girls in full stage make-up. At that time the standard face sported two-inch false eyelashes and dark rays extending from the lower lashes to the general vicinity of the jawbone. It was later replaced with the even more startling corpse look.

"In time I got the hang of how to get my subject across and discovered that a combination of complete honesty about what you didn't know and a healthy respect for student intelligence worked wonders. In spite of the misleading name of the school, it does include courses in management and engineering, the former applied to the apparel industry and the latter to the rapid automation now being applied there.

I divided my time roughly between the all-girl classes and the all-men classes in Management and Engineering; particularly one-year courses patronized by men who already had college degrees. They drew students from all parts of the world.

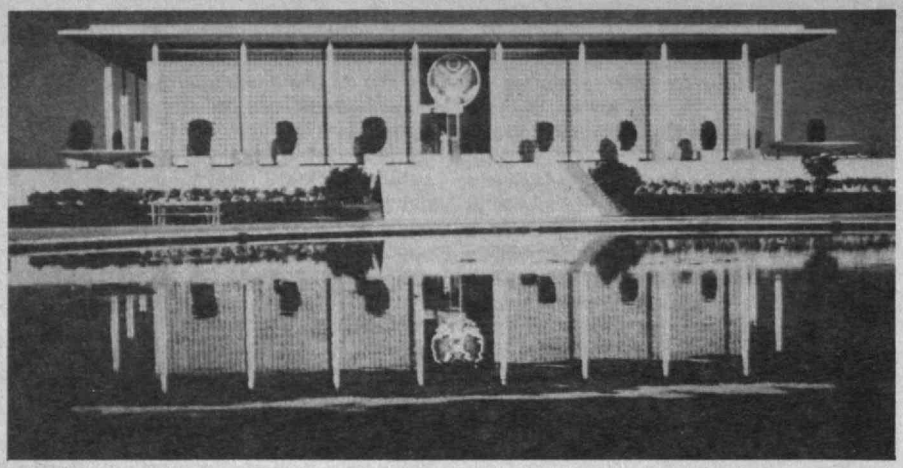
"I also liked the vacation schedules. I spent the summer of 1967 in Morocco, mostly in a Spanish *casa* on top of the cliff overlooking the Straits in what is locally known as the Marchand. I got there on a freighter via Antwerp and liked that mode of travel so much that I have spent all the summers since in the Mediterranean, sometimes predominately in the Northern ports of Spain, France, Italy, Greece, and the mid-East, Bierut, Lattakia, and one summer in Alexandria to pick up the knocked-down Temple of Denur that Nasser gave to L.B.J. and he in turn gave to the Metropolitan Museum. Other years I would concentrate on the North African and Turkish ports, Tunis, Tripoli, Cyprus, Izmir, and Istanbul. The restorations at Ephasis and Antioch even got me reviewing the history of the area.

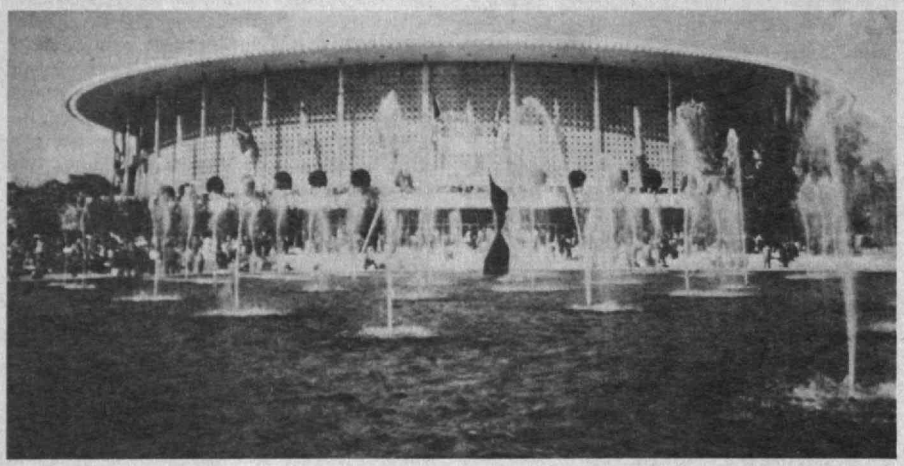
"A quaint legislative misconception about senility forced my retirement this January as I shall hit 70 in April. I shall miss my classes as the student contacts did much to help me understand the changing attitudes of the times but I may find ways to get in an occasional term of three or four hours per week even after official retirement. At least for the present I shall remain in the club here though I may make trips in the fall and spring, reserving the summer for the Cape.

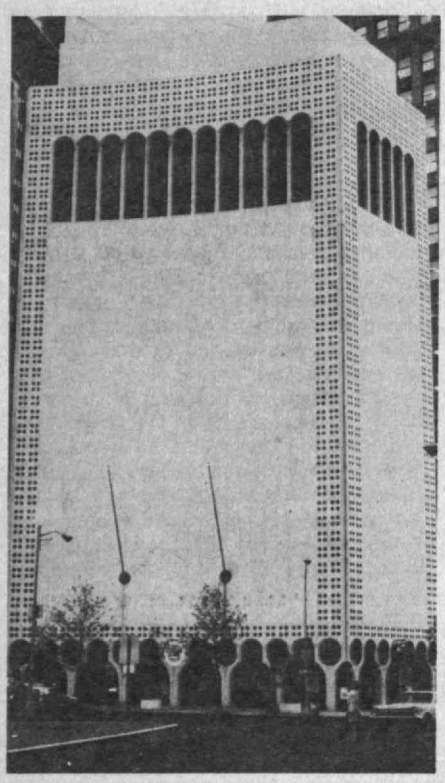
"Sorry to miss the 45th but it came in the midst of final exams. Better luck for the 50th. Keep up the good work on the column. Even those of us that don't write, read. Sincerely, 'Hoppie.' "

Mrs. Adelaide Cummings wrote Don Severance about **Larry Cummings**' death. Larry was 70 and had retired as Secretary of the Institute of Electrical Engineers. Upon retirement, Larry and Adelaide moved to Victoria, British Columbia where Larry pursued his life-long interest in amateur radio. . . . A notice from the Alumni Association tells us that **Cedric Thompson** died in October 1971. We had not seen Cedric for several years and his passing came as a surprise. Cedric had been active in the Lions Club for many years. During his active business years he did a good job for us in ridding our previous home from termites and rebuilding the damage.

With gratitude to G. E. H. we add only our Cheerio!—**George Warren Smith**, P.O. Box 506, Pigeon Cove, Mass. 01966







Pictured above are three of Edward Durell Stone's edifices. Top: the U.S. Embassy in New Delhi; center: the American Pavilion at the 1957 Brussels World's Fair; bottom left: the Museum of Modern Art, New York; and bottom right: the architect himself.

Architect for the World . . . but Not for Himself

Edward Durell Stone, '27, has been responsible for the design of scores of notable buildings—the John F. Kennedy Center for the Performing Arts, the U.S. Embassy in New Delhi, the American Pavilion at the 1957 Brussels World's Fair, the General Motors Building in New York, the Standard Oil Tower in Chicago, and soon a $50 million resort complex near Dubrovnik, Yugoslavia. Among his recent commissions is the Andrus Center at the University of Southern California, a building devoted to gerontological research in which is located the headquarters of the American Association of Retired Persons.

Upon opening that building, Mr. Stone spoke with Arthur S. Freese in an interview for A.A.R.P.'s magazine *Modern Maturity*. Here are some of Mr. Freese's questions and Mr. Stone's responses, reflecting his experience of nearly 50 years as a distinguished practicing architect:

Which of your buildings do you like the best?

Architects go through phases in their careers. The Museum of Modern Art was in what we then called the "international style." When I was 50, I built the U.S. Embassy in New Delhi and it has a sentimental attachment for me—it was a landmark in my career, a striking departure and an individual personal approach. [This building has been called a masterpiece, one of the most significant structures of our century.]

What should architecture be?

The architect should never approach any problem with a preconceived idea. The building should grow out of all the circumstances—its relationship to the community, the reason for it, the client's wishes—all the considerations unique to that particular problem.

How important is good architecture to a happier world?

It's one of the factors profoundly affecting man in his environment. Man responds to a beautiful environment. The Italians, for example, love the beauty of their cities and villages—they know how to live in them and relish them. They're planned for people, and the people are happy even though most of them have only very modest incomes.

What kind of home have you designed for yourself?

I haven't. It's amazing what you can do to express your personal taste by the transformation of a house, but I've never *built* a house for myself. Like the proverbial shoemaker? Exactly!

Should people change homes at different times of their lives?

My avocation is travel. Seeing how past civilizations lived inspires and recharges me. But I can only speak for myself—I like change, and I don't know how many different places I've lived in New York, Long Island, Connecticut. I think change is good for everyone.

How good is today's architecture?
Not very. In my profession—like most, I'm told—there are only a handful of architects who are any good: only 10 per cent are really qualified. I don't know whether I should be *in* that 10 per cent, but if not, it isn't for lack of effort!

How do you see the profession of architecture?
The responsibility of guiding a government or a great corporation in the expenditure of sometimes hundreds of millions of dollars is a fantastic vote of confidence, a great privilege not given to many people and I take it seriously. There's a moral obligation not to be cavalier with expenditures, to try to bring to this scene more than you derive from it. It's always hard to reconcile dreams with dollars—but that's one of the principal objectives of architecture.

What changes for the better have you seen in architecture?
I don't find many things that inspire me. There hasn't been much striving for excellence in architecture here since Thomas Jefferson. I would hasten to add, though, that in the last 20 years there *is* a concern about the evergrowing problems of pollution.

Should we have community planning for future building?
The only city the United States ever planned was Washington, D.C. Thomas Jefferson was an architect and George Washington a surveyor; they started us off in a fabulous manner. But the country grew so fast that it was built without advance planning, and this was one of history's major irresponsibilities. Since the 1850s, nothing has been done right. Now it all has to be done over—and it will be. There's more realization now that buildings are not single objects but must all relate to a large pattern—should all be fitted into a grand plan.

How much attention should be given to ecological balance and the need to avoid overcrowding?
Only 20 years ago, no one had the faintest realization that we'd ruined our environment, poisoned our rivers, that our air was dangerous. They didn't even *use* the phrase ecological balance. Now they're in a panic.

We need more parks and plazas in the cities, less crowding, more room; places where people can be free of automobiles, like beautiful Venice, a city of pedestrians.

What do you consider the world's greatest danger today?
I don't think there's any easy answer, but the single most alarming thing is the prospect of overpopulation.

What do you think is the world's greatest need?
Granted the basic problems are food, shelter, and so on—but education should dispel all these. Man has always relied on his spiritual life and should continue to do so.

27

Last month's deadline permitted only a brief report that **Bob Bonnar** had died on February 12. Your Secretary's file is bulging with the record of Bob's accomplishments in business, in civic activities, and in alumni activities. After graduation, Bob went home to Fall River to work for American Printing Co., at the same time taking graduate courses at Brown University. He had become Technical Director by 1935, when the company discontinued operations, and he then joined General Dyestuff (later part of G.A.F. Corp.), where he spent the remainder of his business career. He was successively Technical Representative; Technical Director (1939); Dyestuff Sales Manager (1953); Director of Marketing (1959); Director of Industry and Government Relations of three G.A.F. divisions (1960); Director of Industrial Relations of the parent company (1963); and Corporate Director of Purchasing (1966) until his retirement in 1971.

Active in many industrial associations, he had been President of the Association of Textile Chemists and Colorists and of the Vat Dye Institute. In 1963, the A.A.T.C., named him to receive the Harold C. Chapin Award for outstanding services to the industry. He was the author of many articles on textile dyeing, and served on a number of government advisory committees.

Bob was a member of the educational council of M.I.T. for the New York City area; for three years a member of the Board of Education of White Plains, N.Y.; and active in his church and in many charity drives. In 1931, he married Frances M. Palmer; in addition to his wife, he is survived by his son, Jay R. (also an M.I.T. graduate) and Jay's three children, and by his daughter, Ardith F. He was Vice President and Treasurer of our Class and, with Glenn Jackson, the chief moving spirit and organizer of our Reunions and intermediate get-togethers.

But a catalog of his activities falls far short of telling Bob's story. Bob and Fran and Marion and I sat together at the Junior Prom (How many others of our Class married the girl they took to the Prom?), and for all these years I have marvelled at how Bob's sense of humor livened every gathering of which he was a part; how his tact and thoughtfulness put everyone at ease; how his spirit and initiative encouraged the rest of us; and how he gave direction and purpose to enterprises that might otherwise have drifted. How can words describe his talent for friendship? What can one say in a few paragraphs of alumni notes that will not seem wholly inadequate to those who knew him?

Sadly I must report that we have lost three other members of our Class: Dick Donald, who died on November 2 last; Bob Hancock, on January 13; and Harvey Fitts, on February 11.

John Kenneth (Dick) **Donald** joined the Class in our junior year, after previously attending Columbia University, and went on to take a master's degree in 1928. He had held various positions with American Telephone and retired in 1971 as Staff Supervisor. His children had grown up and left home. Dick was a neighbor of mine, just two streets away, and we have both been members of the Scarsdale Town Club for many years, but I did not know it until I received word of his death. Scarsdale is a village of only 5,000 families. He would have been a member of the same Neighborhood Association, and sent his children to the same elementary school, as I. It is a comment on our modern way of living. . . . **Robert W. Hancock** was Chairman of the Board of Hancock Industries, Inc., of Jackson, Mich., a family firm which manufactures automobile components, and has been very successful under Bob's leadership. . . . **Harvey Fitts** was President of Clark-Wilcox Co., of Allston, Mass., distributors of heavy earth-moving and industrial equipment. He and the late Frank Wilcox established the firm in 1927. He was born in Framingham, Mass., and lived there all his life, though he had recently bought a winter home in Sarasota, Fla., where he died. He had just retired as a vice-chairman of the board of directors of the Framingham Trust Co., a post he had held for 30 years. He leaves his wife, Frances (Ockerman) and twin sons, Stanton and Stephen, both of Framingham.

Now for some more cheering news. **Joe Harris** writes from the middle of the South Atlantic (en route from Buenos Aires to Capetown) that he and Ann, and Dick and Mary Hawkins, are enjoying their globe-circling trip on the *M.V. Oriental Carnaval.* From Capetown they go to Durban, Mozambique, Singapore, Hong Kong, Taiwan, Japan, and back home across the Pacific—all at a leisurely 15 knots. . . . **Ed Cahill** writes, "I am still single and living the quiet life of a retired petroleum geologist here in St. Louis with my sister. I sometimes miss the excitement and action of the oil-boom days, but when the winter rain sluices down, I'm just as glad I'm not still out in the field, bogged down in the mud on some wildcat well."

Al Buffum is still traveling and fishing: "This last year, after a trip to Bariloche, Buenos Aires, and Rio, I took a week for fishing in Labrador in early July, and then a week on Victoria Island in the Arctic for some fabulous char fishing. Our latest travels were eight weeks to eight countries behind the iron curtain. Very interesting, but not particularly a pleasure trip. We do not realize our blessings in being citizens of the U.S.A."

Jottings: **Robert L. Petersen**, who lived in Santurce, P.R., after his retirement from the Navy, had moved to the Virgin Islands. Now I have a note from Percy Richardson that Bob has moved back to Santurce. . . . **Manuel Ruiz** writes from Spain that he plans to attend our 50th Reunion. . . . **Tom Scott** is still at the U.S. Tariff Commission in Washington, D.C. Last year he took two trips, one to Scandinavia and one to Mexico . . . **Sara Scudder**, who retired as senior bacteriologist of the New York City Department of Hospitals, is pursuing her hobby of making collages of world events, a permanent record in photostatic negatives. . . . A brief personal note from **Jim Lyles** tells me that all is well there. . . . **Russ Westerhoff** has carried out his plan to

retire as Chairman of Ford, Bacon and Davis in February. . . . **Johnny Drisko** has cut down his work week to four days. The Alumni office lists a new address for him in Camden, Maine, but since his letter comes from Maplewood, N.J., I am guessing the Camden address is a summer home.

I have these additional address changes: Dr. John P. Vinti from Allston, Mass., to Brussels, Belgium; Arthur J. Tacey from Chappaqua, N.Y. to Cooperstown, N.Y.; Adelbert N. Billings from Cumberland, Maryland, to Leisuretown, N.J.; Ira D. Beals from Berkeley, Calif., to El Cerrito, Calif. Allan Gifford to the Cape from Chelmsford, Mass.; his new address is P.O. Box 373, Plymouth, Mass.—**Joseph H. Melhado**, Secretary, 24 Rodney Rd., Scarsdale, N.Y. 10583

28

This is the last opportunity we have to remind you of the Reunion at Bald Peak Colony Club, Melvin Village, New Hampshire June 1, 2, and 3. If not already done, please get in your reservation card and questionnaire promptly. If you do not plan to attend please fill out and mail to us your directory questionnaire so that you will be there in letter and spirit if not in person.

A number of recent notes and letters were written to us in relation to the Reunion. **Frank Sweeney** and wife Edie are looking forward to the occasion. Frank retired from Graybar Electric Co., one year ago. Now he does consulting work in the telephone interconnect field and spends what time he can improving his golf scores. . . . **Bill Rothwell** wrote that he will be unable to attend because of business conflicts. He is President of his company, William P. Rothwell and Associates in Hancock, Mass., management consultants to ailing companies. . . . **Stew Newland** and his wife plan to trailer their way from Pleasanton, Calif., (where they are visiting their daughter) across the country via the Pacific Northwest, western Canada, Wyoming, southern Michigan and on to Meredith, N.H., where they will camp. . . . **Sam Weibel** was concerned because mail was being sent to his summer address with consequent risk that it would not reach him in Cincinnati. . . . **Vic Decorte** was afraid that notices sent to him might be too slow to reach Rome, Italy unless sent airmail. He and Alice are definitely planning to be at Bald Peak. They will sail from Naples on the *Raffaello* May 14 and arrive in New York on May 21. . . . **Fred Riley**, after reading about the Reunion in Class Notes, wrote to us in February to make sure of getting his reservation in early. . . . **Don Perry** also wrote in February to ask about registration material. He and Vera, recently married, are all set to enjoy the Reunion. **Fritz Rutherford** was another early applicant. He and Jo planned to leave in February for a month-long trip and cruise to Florida and the Caribbean. They wanted to be certain of their reservations at Bald Peak. **Chris Case** wrote to **Jim Donovan** even back in January to get some preliminary information. Chris and Ruth will attend and they report that Betty and **Dud Smith** also plan to be there. Chris says he is very busy but enjoying his work as Property Assessor for the City of Willimantic, Conn. Jim had letters also from Anne and **George Palo** and from Priscilla and **Roger Haven** all of whom are looking forward to the events of June 1 to 4.

Frannie Donovan was thoughtful in sending us a news clipping from the *Boston Herald American* of Feb. 17, 1973, wherein a photograph shows **Gus Solomons** being sworn in as a member of the Cambridge (Mass.) Redevelopment Authority. Gus is a former member of the Cambridge School Committee, is presently associated with the Metropolitan District Commission and has served in many other important posts of public service.

We have a nice letter from **Warren Fleming** in which he tells us "Corning was really hit hard by 'Agnes' on June 23 last year. Most of the business section was flooded, hundreds of people were left homeless and about 20 lost their lives. Fortunately, we were out of town at the time and did not have to be evacuated. Our home of 35 years was flooded. We were lucky in finding another house up the hill and are now busy buying new furniture and settling in. Although I took an early retirement in 1968 for health reasons, I am still doing some consulting for Corning Glass Works. We had to cancel all vacation plans last year but look forward to the 45th in New Hampshire in June."

In the Registration Bulletin (Quarterly by the National Council of Engineering Examiners) for January, 1973, we learn that "**James A. McCarthy**, former member of the Indiana Board, has been designated by that body as an emeritus member for a period of one year following the termination of his automatic classification as an associate member." . . . **Herm Swartz** sent in a news clipping but failed to include a source reference. We can't give a press credit but the item is well worth passing along: "Congratulating Mark Hanna of Ken's Steak House in Framingham (Mass.) on finishing second in the doubles competition at the first invitational tournament of the Reservoir Racquet Club draws only a tight smile of acknowledgement. On the team that beat Hanna, who is in his late 30s, and his partner was engineer **Ed Poitras**, who happens to be 72. 'He's not for real' sighs Hanna."

On March 1, Betty and **Carl Feldman** left by plane for a three-week trip to Israel, Tel Aviv, Jerusalem, and Haifa. They planned to visit son Peter who sings and heads the vocal bass section in the National Opera of Israel. Ann and **Will Tibbetts** took off in late March for another of their long trips abroad. This time they planned to spend two months visiting and exploring the Canary Islands, Morocco, Portugal and Spain. They always research and study in advance the places they expect to visit. On this trip they are especially eager to visit the newly discovered prehistoric dwelling caves in southern Spain. . . . In this age of scurry and near sonic flight for travel, it is restful just to read of the freighter cruise taken by Louise and **Ernie Knight** last year. This was an unhurried six and one-half week trip on the *Export Ambassador* to Morocco, Portugal, and numerous Mediterranean ports. With a passenger list of only 12 it is easy to understand why it was a friendly and intimate group. At the various ports of call there was usually enough time during cargo transfers to permit visits ashore. Among the highlights reported were: A stop at Tunis with a ride to nearby ancient Carthage; prowling the bazaars at Sfax and Casablanca; a stop at Tripoli and into one of the finest museums anywhere; a ride from Beirut, Lebanon to Byblos, a town with the longest history of continuous occupation of any in the world; and a trip 60 miles inland to Baalbek, a Roman city of the first century, rich in monumental temple ruins. Other places visited were Antioch, Istanbul and Izmir in Turkey, and Lisbon, Portugal. A color photograph taken aboard the freighter at sea tells us that Ernie and Louise are in excellent health.

We regret to report that **Walter C. Crossley**, Course II, died December 17, 1971. The information came to us in a note from his wife Jessie. "Pete" as he was known to friends, made his professional career with Ingersoll Rand Co., where he was a specialist in sophisticated hoist equipment. He retired in March of 1971 but had continued as a consultant to the company. He was also retired from the U.S. Army but remained active in the Reserve Officers Association.—**Walter J. Smith**, Secretary, 209 Waverly St., Arlington, Mass. 02174

29

Received a post card from **Hunter Rouse** of Iowa City and his wife Doi from the Fiji Islands, who are on a lecture tour in New Zealand, Australia and South Africa. "Sure beats an Iowa winter." declares Hunter. . . . **Paul F. Nocka** writes, "Having retired from the active practice of architecture, I am content to let younger men struggle with the design of medical facilities which my firm specializes in. At the moment, they are designing a medical center for Aga Khan in Karachi, along with a number of hospitals in this country." . . . **Edward M. Tittmann**, retired Chairman of the American Smelting and Refining Co., has been elected a director of the Planning Research Corp., of Los Angeles, Calif.

I regret to announce the death of **Eugene H. Gilman** of Ft. Lauderdale, Fla., in December, 1972, who is survived by his wife Ruth and three sons, two daughters and six grandchildren. . . . We learn also of the death of **Delbert Warburton**, Swansea, Maine, in January, 1973, who is survived by his wife Madelyn, three daughters and eight grandchildren.

Edward C. Roche of Williamsville, N.Y., writes, "I would like to express my appreciation for the work you are doing for our Class as Secretary by keeping us informed of the activities of our classmates. I am still very busy with my work and no thoughts of retirement as yet. Our Class lost a good worker and Treasurer when Edward Farmer died. Greetings to all our classmates." . . . **Louis F. Southerland,**

Jr., of Austin, Texas, is a member of the architectural firm of Page, Southerland and Page, with offices in Austin and Corpus Christi, Texas and Columbus, Oh., with a staff of 90, doing institutional, commercial and educational buildings. . . . **Arnold W. Conti** of Shrewsbury, Mass., has retired as of June, 1973. His current activities include traveling, golfing, local civic projects and management of real estate. "We still have two sons in college and watch with great interest their development in attitudes toward war, racism, pollution and politics. They seem to show much more interest in everything then we did. Our family voted two for Nixon and two for McGovern."

Dr. **Emmette F. Izard**, Hazelhurst, Mass., writes, "I have been retired since January 1, 1967. We spend fall, winter and early spring in Mississippi and late spring and summer in our country home near Springville, N.Y. After shovelling snow for 30 years in Buffalo, N.Y., it is a pleasure to sit and watch the precipitation come down in the form of rain and run down the ditch." . . . **Nerses Der Marderosian** of Needham, Mass., has retired from the family-owned business of oriental rugs, since July 1970. He has four children and seven grandchildren. . . . Since his retirement from Mobile Oil Co., three years ago, **Paul V. Keyser** is leading a busy and active life as a consultant, a Director of Witco Chemical Co., and Apso Oil Co. He was recently elected as a member of the M.I.T. Corporation. He is also Chairman of the Visiting Committee to the Sloan School. Though he lives in New York most of the time, he recently bought a house in Carefree, Ariz., as a retreat.

M. Edgar Powley, Jr., of Wilmington, N.C., writes, "Retirement day, something for which most of us have been waiting for, finally arrived. I persuaded the management of my company to give me one year earlier retirement. We picked Pine Valley, just outside of Wilmington as the ideal spot for our future home, which is 15 minutes ride from Wrightville Beach. No snow, blue sky most of the time and handy to golf course. We designed and built our house, which we are enjoying tremendously. This lazy life appeals to me, though I may change my mind about it as time goes on. Thanks for your birthday greetings and best wishes to all my old friends." . . . The **Ivar T. Malmstroms** of Needham Heights, Mass., are announcing the arrival of their fifth grandchild—a boy born in Denver, Colo., last September. Their younger daughter, Polly, lives in St. Louis, Mo., and Jackie and family are headed for Hawaii where Major Lane will be teaching R.O.T.C. at the University of Hawaii. On the tragic side, Florence's father passed away at the end of January. . . . **Lawrence S. Newman** of Manset, Maine, writes, "We are still spending at least six months in Delray Beach, Fla., and summers in Maine. Our chief interest in Florida is square dancing to taped music and live callers which is good exercise and mentally stimulating. During the summer I help my younger son, Jariss in building boats in his shop. He is busy building 36 ft. fiberglass hulls that are finished at other yards for pleasure or commercial use. He also builds a 25 foot fiberglass pleasure boat. His smallest one is a 12 foot fiberglass yacht tender and that is where I keep busy. My father, who will be 97 in April, lives nearby, both in Florida and Maine. Though one of his legs was amputated three years ago, he plays shuffle board during the winter from a wheelchair."

Warren W. Walker of Montclaire, N.J., writes, "Dear Karnig, How nice of you to remember that I have reached the ripe old age of 66. Since I control my company, I am not being forced to retire. We started a company pension plan some six years ago which helps to defer profits to later years. Nineteen seventy two was the best year we have had and it looks as though 1973 will be even better. My company, which is known as Graphite Metallizing Corp., was founded in 1913 as the result of a patent on a process invented by the Otis Elevator Co. One of our main products is Graphology bushings, electrical brushes and contacts. At a recent N.A.P. meeting, I met a man who was 105 years old. His secret for longevity is 'exercise morning and night, walk to and from work and learn something everyday.' I have always advocated that retirement should come when contribution ceases. There is too much talent being wasted by retiring people according to age. My best wishes to all."

Frank Mead, President of our Class, and his wife Mary, spent the month of February in Sarasota, Fla., near to golf courses and fishing. On their way back home, they stopped over at Ft. Lauderdale, which gave them an opportunity to visit with **Hugh Hamilton** and his wife Helen, accompanied by your Secretary and his wife Helen. Prior to our visit, in conversation with Helen (Hamilton) I learned that Hugh had surgery on his leg, transplanting a blood vessel during January at the Mass General Hospital. The operation was a success and Hugh looked and felt very good. We spent an enjoyable evening together at their home in Boca Raton. Hugh's condition has improved a great deal since his stroke a few years ago. His speech is normal, he can walk with a little help and a brace on his bad leg. He is enjoying life in a normal manner and his outlook for the future is excellent.—**Karnig S. Dinjian**, Secretary, 6 Plaice Cove, Hampton, N.H. 03842

30

At this time of year the flaps of the Alumni Fund envelopes provide a welcome source of brief communications from our classmates. From this source we learned that **Hal Spaans** retired from The Bell Telephone Co., of Pennsylvania as of July 1, 1972 "one week shy of 42 years after I reported as a cub engineer in 1930." As Director of the Company's Training Center for five years, he was responsible for their engineering training program and found the work most interesting and rewarding. Hal reports the recent arrival of a third and fourth grandson, but no granddaughters as yet. He says he sees **"Grange" Schrader** regularly at meetings of the M.I.T. Club Executive Committee. . . . **Ernie Reisner** is in his third year of retirement and "it gets better all the time." He expects to be able to do justice to his sailboat next summer.

Lauri Lindell is still operating his architectural firm of Lauri A. Lindell Associates in Lexington, Mass., specializing in housing, apartments, commercial and municipal buildings. . . . **John Pratt** is still on 100 per cent V.A. disability pension as the result of a "ruptured aortic aneurism" he sustained about two years ago. However, he says he has almost completely recovered, although he is still on a diet of 19 pills per day. . . . **Graham Walton** reports that he is enjoying retired life which he devotes to travel, golf, and a limited amount of consulting work that stimulates his professional interests. . . . **Frank Hankins** retired five years ago with total disability due to Parkinsonism. He says he is doing quite well currently thanks to L-Dopa which does wonders but is sometimes hard to take. At the time of writing he was enjoying the company of five granddaughters, two of whom were less than a month old. He is still living in Franklin Lakes, N.J. . . . **Harold Plant** reports the recent arrival of this third granddaughter.

Ed Huson retired in February 1971 as Special Advisor on Public Utilities to the Securities and Exchange Commission in Washington. He also retired as a Commander U.S.N.R. as of January 1, 1967. Since retirement, he has been active as Treasurer of the National Association of Watch and Clock Collectors, Inc., of Columbia, Penn., which has 21,000 members and 62 local chapters. He collects, restores, and studies the history of antique American clocks and also writes and lectures extensively on the subject. Ed is active in Masonic work and is presently Scribe of Singleton Chapter Number 4, Royal Arch Masons in Washington. He reports having recently seen **Al Bird**, who is still working for the Department of Defense, and **Joe Harrington**. . . . **Paul Kimberlin** has retired and has just completed a new home in Pearce, Ariz., about which he is very enthusiastic. According to his report he has coyotes, desert chicken, quail, red dirt and tumbleweeds right in the back yard and sometimes in the front yard too. The Kimberlin's son Kenneth, who attended our 35th Reunion, is now working for Bethlehem Steel in Burns Harbor, Ind. Paul reports having recently received a letter from **Lester Meyer** who is still working as an engineer for the State of Illinois. . . . **Jean Kresser** retired as a Fellow Engineer from Westinghouse in October 1969. Since then he has spent about 60 per cent of his "leisure time" working as a consultant in the San Francisco area on problems relating to transmission and distribution of electric power, including coordinated substations, systems engineering and system studies. His hobby is the study of advanced mathematics.

It is regretfully necessary to report the death of several more of our classmates: **Roy Ide** in May 1969; **Philip Riley** on September 9, 1972; **Warren (Chick) Dolben** on December 18, 1972; and **Arthur Anderson** on February 23, 1972. Unfortunately, I have very little information about any of them other than what is

given in the Alumni Register. It appears that Roy was teaching chemistry at Lander College in Greenwood, S.C., in recent years. Arthur Anderson was an Industrial Engineer at the U.S. Navy Yard in Washington. I saw Chick Dolben at an M.I.T. meeting several years ago, at which time he was running three small companies in northern New Jersey, making such diverse products as aerosol ingredients, dust control agents, room deodorants, compressed air meters, and moisture meters for grain. Philip Riley lived in Seabrook, N.H., at the time of his death and had apparently retired some years ago.—**Gordon K. Lister**, Secretary, 530 Fifth Ave., New York, N.Y. 10036

32

Dr. **Alex Burr** was recently awarded a certification for life membership in the National Society of Professional Engineers by the Bismark, North Dakota chapter of the state engineering society. Dr. Burr received the award for over 30 years of service to the society and to the engineering profession. He was one of the first members of the state board of registration for professional engineers, serving until 1953. He retired from engineering in 1967. During his career he served in the education field at Wayne University, M.I.T., Westminster College and as Dean of the faculty at Jamestown College.

Lester Glickman has retired after 31 years of civilian service with the Department of the Navy. Lester was Director of the Quality Evaluation Laboratory, Naval Underwater Systems Center, Newport, R.I., for the past 20 years. . . . **William Barker** sends word about his disappointment at seeing so few of his classmates at the 40th Reunion. Will and his wife have been spending part of the winter soaking up the sunshine of St. Croix in the Virgin Islands. . . . **Maurice D. Triouleyre** advises that he has left industry for management engineering work in the hospital administration field. He finds this new activity a different world, but challenging, and much needed.

Your class officers hope to see many of you at the **Mini-Reunion**, Sunday, June 3.—**John W. Flatley**, Secretary, 6652-32nd St., N.W., Washington, D.C. 20015

33

We have two cards and a letter from **Beau Whitton**. The cards were written when he and Daphne were on their trip to the West. While he was in Columbia, Missouri, seat of the University of Missouri, Beau had lunch with **Cooper Cotton**, Course XVII. They had not met since June, 1933. Cooper recently sold his successful lumber and millwork business, and is employed by the University in construction and maintenance. Cotton is thinking of joining the retiree fraternity. In New Mexico, Beau saw a feed lot with 14,000 head in it, but few black ones. Haw, Beau you see fewer cadillacs too! Now, he writes a short letter, upon his return to North Carolina. While passing through St. Louis, he and Daphne had supper with Roz and **Ellis Littmann** and another M.I.T. man and wife. Here is a good one; Beau says that he and Daphne will attend the 43rd Reunion, come June. Wonders will never cease, or is it that others do make mistakes. Beau, you be at the Chatham Bars Inn, come June, and you can call the Reunion anything you wish.

Another from the deep South; an old and faithful classmate, **Thomas K. Fitzpatrick** (he now leaves out a T). Tom works mostly at consulting work in architecture, which takes him all over the Southeast. He is at present doing an exciting garden room for the Oglethorpe Club, and a new approach to rehabilitating facilities for medical teaching and practice, at Vanderbilt University, Nashville. Also he has made trips to Haverford University and the University of Virginia, just to check up on how his successor is doing. The Fitzes left in December on the *Christoforo Columbo,* for six weeks in Spain and southern Portugal. Tom thinks well of our South Seas trip, and says that this is the area where they will visit on their coming freighter trip. Tom still plays some tennis and is quite active in the work of the Highlands, N.C., playhouse. Important; Tom has joined up with the newly formed Atlanta M.I.T. Club.

Our class powers-that-be have asked me to put in one final mention of the 40th fund, and I am pleased to do so. No classmate can have escaped the full meaning of the fund as it has been presented to us all. I submit that all active classmates ought to feel obliged to make some sort of contribution to this fund, according to their means, and according to his more generous inclinations. All of us will have our names on the honor list of those who have contributed to M.I.T. at the traditional 40th fund campaigns. So, if you have not come through, do so and at once. There is little time left as you read this, and we must go over the top. The class immediately preceding us ran into some hard luck, what with the earlier mild recession. We can't have any such excuse. Give, please.

From **Bill Baur**, we get a fine message which follows a stag trip to Germany, where he attended a Golden Wedding Anniversary, an 80th birthday, and a wedding; all in or near the town of his birth. Apparently Bill had himself the proverbial ball, dinning and wine tasting with his buddies of 50 years ago. Gee, he gets two reunions within a year, one in southern Germany. Bill asserts that the wine was excellent, so much so as to cause them to drink it all themselves, and export none. It must be that the supply was severely depleted, after Bill's visit. The Baurs spent four months in New England last summer, not making it to Exeter, but they will after the 40th, which they will attend. Son Victor is Sales Manager with the Lowell Gas Co. Thanks, Bill and Clare.

Now we have another who writes seldom, but very well indeed when he does—**Ivor N. R. Morgan**. An old Course II, Ivor still holds a soft spot close to my heart. So, daughter Laura is a medical secretary at the White Plains Hospital. She is also active in the young people's group in the Marble Collegiate church in New York City. Son John took a wife a year ago, Sandy Joy, in Altamont, N.Y. John took his degree at R.P.I., Troy and received his master's at M.I.T. Then he went to Saigon with a N.R.O.T.C. commission. The Morgan's first grandchild was born in Saigon at the army hospital. They have since returned home and John is now working at G.E. Their daughter Liz graduated from Cornell in 1970 and now lives in New Haven where hubby sells Johnson and Johnson drugs. Son Tom is to complete his studies at Westchester Community College, next year and is headed for R.P.I. or Syracuse. Ivor says that he soon will be the rich uncle of the clan, and go on South Sea cruises. Baby Jane is a high school junior. Her hobbies are discreet dating, where Papa acts as chauffeur, the High School marching team, and teaches a Sunday school class. Laura senior is still secretary of the church, and Ivor is with General Foods, Bird's Eye division, as Senior Engineering Consultant.

John Longley is a blood giver, and does a good job of selling the idea to others. They have done little travelling, but did trailer to Ohio for a family reunion, then back to N.Y., via the Canadian National Exhibition, and the various art museums in Toronto. John is a home workshop fella, and works at it. He is, you will recall, a member of the local fire department as a volunteer, except that he is now driving the big equipment. John played some golf this summer, and was looking ahead for skiing. He and his wife are amateur radio fans, and each have receivers and transmitters in their cars. How about that; if you want to argue with the missus, call her up and talk and she can't reach you. . . . Now for me, a bit; over 40 of the faithful have wished Leona and I a great anniversary trip, for number 50. We both thank you all for your good wishes. We also hope you all make your fiftieth, and in health.

Morris Guralnick comes through with a fine letter. You will recall that Morris started his firm of naval architects in 1947, a period when this type of design was in a decline. He had the faith, however, and it has paid off. His firm, now incorporated, is the biggest (people) and largest (business) on the West Coast. They employ over 100 people, though this figure has been higher. The list of ships is fantastic—the smallest was a 26-foot trailable houseboat and the largest, a 930-footer. The largest one is a 132,000-ton dead weight ore/oil vessel (combo type). Morris and Peggy took a trip to Japan last year to get a look at the shipbuilding and design, there. This year they went to Alaska to observe the oil and gas production fields at Cook Inlet. Morris recommends this trip to the more venturesome. Their two children have presented them with three grandchildren. Morris says that the grandchildren all are fine looking so they must take after him.

See you at the 40th. Please send your intentions to **George A. Stoll**, RFD 3, 45 Taylor St., Pembroke, Mass. 02359, Registration Chairman. Best regards and greater happiness.—**Warren J. Henderson**, Secretary, 1079 Hillsboro Beach, Pompano Beach, Fla. 33062

Frank R. Milliken, '34, President of Kennecott Copper Corp., took the occasion of his receiving the Ankh ("Copper Man of the Year") Award late last winter to explain his views of how public and corporate responsibilities should equate. The industry must learn a lesson from Theodore Roosevelt, he said, by demonstrating "a larger element of toughness, especially when toughness is essential to fairness. In my mind fairness is the most we should ask and the least we should expect . . ."

The Copper Industry: A Plea For Fairness and Toughness

"The time has come for a fair shake!"

The quotation is the theme of the remarks by Frank R. Milliken, '34, President of Kennecott Copper Corp., upon receiving the annual Ankh ("Copper Man of the Year") Award—for distinguished leadership in national affairs on behalf of the copper industry—from the Copper Club in New York late last winter.

The trouble, he thinks, is that nobody is asking, "What's fair to industry?" while making new demands on management and manufacturing.

Two examples:

☐ The copper industry, among many others, is now asked to abide by new environmental constraints and must therefore invest new funds in the name of "environmental enhancement." The problem is not simply that these are additional expenses; the difficulty is that they are superimposed on an accounting and price structure which did not anticipate them.

"Whenever we embarked on a mining venture in the past," said Mr. Milliken, "it was with a reasonable estimate of the costs involved." Now we're being asked to change the ground rules with respect to new production, when in fact "had we known the costs were going to skyrocket later, we might not have gone ahead."

☐ Despite the fact that "Kennecott had taken very seriously its role of corporate social responsibility" in Chile, doing "a careful and conscientious job of balancing the needs of the host country and the 'economic interest' of our stockholders," the Corporation's investment has been wiped out by nationalization.

Before the Corporation's El Teniente Mine was expropriated, Mr. Milliken said, only two out of Kennecott's 10,000 employees in Chile were North Americans, and Chile had reaped $2.5 billion through the Corporation's purchases, taxes, and payrolls. "Once again," he said, "we were victimized by a unilateral and arbitrary change in the rules."

"I'm not insisting on business as usual," Mr. Milliken told the Copper Club. "All of us recognize that we're going to have to make some changes.

"From the standpoint of industry, I believe all of us must demonstrate in the development of any 'new order' a real conviction and some old-fashioned courage in pursuing what's right. . . .

"What I am insisting is that these changes must make 'economic sense.' Otherwise, we might have to post a notice one day: 'We have no copper for sale.' "

34

I'll begin with some items that missed the last issue. First from **Jim Eder**, "I got a very interesting Christmas letter from Y. T. Chiu from Hong Kong. He wrote that he had retired from business (Sales Manager, Cal-Tex) in early 1971. He visited the U.S. with his wife in mid-1971 and saw his many children who are here. His eldest son, Y. T. Jr., is in private practice in plastic and reconstructive surgery in Youngstown, Ohio. He has an American wife and four children. His third son, Tim-Ho graduated from Lehigh (Ph.D.-Chem) and is working with Avco Everett Research Labs in Revere Beach, Mass, with his wife. His fourth son, Tai-Woo (Ph.D.-Chem) is doing post graduate work at Lehigh. The fifth son, Oui-Shin expects to get into medicine also. His youngest son, Sui-Tat, Ph.D. Princeton, is doing post-doctoral work there and will try to get a job at M.I.T. or Harvard, having given a seminar at each. Daughter Vivien is married to a Dr. Ko and lives in California. He speaks of having a generation gap like all of us, but I think it's the other way 'round! This is a truly remarkable record for a single family. But I can't help what is probably a somewhat smart-alecky thought—if the family all got together at one time, with all that education, who would you send out for beer?

I may have mentioned before that **Ernie Massa** had retired, but with his fund contribution comes the note "Jeannette and I are enjoying our retirement in Pompano Beach, Fla. We live in a condominium on the beach called the Parliament House. . . . **Lee J. Rusling** writes "As an investment counselor and amateur economist, the present sorry fix the world finds itself in, makes for a very challenging avocation—married 39 years, three children and four plus grandchildren."

From several sources I received word of the death of **Peter Barry** in January, after some two years of illness. Although he did not continue at M.I.T. for his degree, as one member of the Class of '27, in writing about him, said, "Few graduates have made more of a contribution to their home towns or have enjoyed the love and respect of such a wide circle of friends." Peter had worked at the Rochester Gas and Electric Corp., for 30 years and was superintendent of steam distribution. But it wasn't his devotion to civic affairs that made him noteworthy. He was a city councilman for 16 years and served as mayor from 1955 to 1962. He was President of the New York Conference of Mayors in 1960 was named "Man of the Year" twice by Rotary and Kiwanis Clubs. Over the years he had been active as an officer or director of many Rochester social service agencies and businesses. In 1965 Peter joined the Monroe Savings Bank as Executive Vice President, became President in 1968 and was Chairman of the Board at the time of his death.

Unfortunately, I must report the loss of another of our classmates, **John A. Troxell**, also in January. He had received his S.M. in Civil Engineering at M.I.T., and in 1934 joined the Puget Sound Bridge and Dredging Co., of Seattle. He held several positions with the company and in 1948 resigned to form his own concern, the J. A. Troxell Construction Co. In 1968 he moved to San Francisco. Because of a heart ailment he retired last year as Vice President of Operations for Santa Fe-Pomeroy Inc., of Orange, Calif. As a professional engineer his career spanned 36 years of administration and design of marine construction projects on the West Coast and included overseas assignments in Australia, Iran, Indonesia, and Singapore. John is survived by his wife Josephine, two daughters and five grandchildren. On behalf of the Class I would extend our sincere sympathy to Mrs. Troxell on her loss.

In looking over the Notes in the February issue I find that somehow one item got mixed up. It was **Constant Chase**, not **Edward Cantor** who wrote concerning the loss of his wife Frederica. Since this was one time I din't keep a carbon of my notes, I don't know at this moment what Ed Cantor had written about. Will you tell me again, Ed—I'll get it correct the next time. . . . Once more **Ted Rimbach** was kind enough to include me on the "Rimbach Review '72" mailing list. They had held it up this year so that it could include a Christmas Eve picture of all 12 of the family—the first Christmas in five years that they'd all been together. The highlights of the year were the marriage of daughter Nan and a new grandson to other daughter Jean. Unfortunately Ted's wife Sylvia could not be as much help following this latter event as she wanted. While at her daughter's she fell and broke her left arm in two places but she seemed to be fine in the picture. Ted is doing a lot of travelling and attended both the American Water Works Association meeting in Chicago and the Water Control Federation Convention in Atlanta. One son, Rich, is active is the Chicago section of the National Society of Corrosion Engineers and his brother Don is continuing his work on the geology of caves and springs.

Ted also included a clipping from the

St. Louis Globe Democrat covering their citation of **Harold E. Thayer** as *Globe Democrat* Man of the Year for 1972. This award is made not only in recognition of work done in aiding economic and development growth in the city but also for tremendous efforts in civic, cultural, and humanitarian work. I'm sorry to see, however, that Harold had lost his wife last July after an illness of some time. Our condolences are belated, but joined with applause for his ability to keep up the work that brought this award, despite the personal problems bearing on him at the same time.

I'll close with two more Alumni Fund notes. Just two years ago there was an item from **Elizabeth MacGill** in Toronto on her work on a Canadian Royal Commission on the Status of Women. She has apparently received personal recognition as she writes, "In 1971 I was awarded the Medal of Service (for aeronautical engineering) in the Order of Canada and in 1972 was made an officer in the Order." . . . The second note provides a nice "up-beat" for a finish and comes from **Art Conn**, "The most important news is my marriage in June to Iren Farkas. (My wife Bernice had died in May 1970, the year I was President of the American Institute of Chemical Engineers). We spent a delightful honeymoon in Banff and Lake Louise, enjoyed a conference on energy sources for the future in Vermont, then to Japan for the Pacific Chemical Engineering Congress. Busy, busy, busy." It always makes you glad to see someone finding a new source of companionship and support after a loss that could only have been very grievous at the time.—**Robert M. Franklin**, Secretary, Satucket Rd., Brewster, Mass., 02631; **George G. Bull**, Assistant Secretary, 4961 Allan Rd., Washington, D.C. 20016

35

Although this news is a year late I am sure that it is new to these notes: Stocky, Dr. **Walter Stockmayer**, Professor of Chemistry at Dartmouth College, was awarded an Honorary Doctors Degree from the Louis Pasteur University, Strasbourg, France at ceremonies commemorating the 150th anniversary of the birth of Pasteur. A French newspaper citing the occasion said Stocky was "among those American researchers whose works carry authority throughout the world." We are very proud of you, W. Huge S!

A. Rufus Applegarth, Jr., is not only President of Aradar Corp., but of the National Pilots Association as well. . . . From executive suite: **Charles P. Bowen, Jr.**, is now wearing three hats at Booz, Allen: Chairman, Chief Executive Officer and President—"a heavy load even for a Consultant," says *Business Week*. . . . **Harold H. Everett** has been elected to membership in the Sons of the Revolution thru descent from his Revolutionary War ancestor, Thaddeus Stowell.

We regret to announce the death of **Harold M. Oshry** on February 6, 1973, in Crawfordsville, In. He was Vice President Operations and Director of Braden Industries of Tulsa as well as part owner of the Lew Wallace Motor Inn and Russell Dawson Construction Co., of Crawfordsville. We extend our deepest sympathy for the Class to his widow, Barbara, sons George, Hadley and Michael, and daughters Rosemary and Jo.

We received the following brief notes from the Alumni Fund envelopes: from **Ken Finlayson** he writes that he is now with Day and Zimmermann, Inc., of New York City as Vice President, Engineering and Construction Division. . . . **Joseph S. Oldham** reports that he has retired from Government Service (Post Office) and from the U.S.A.R. . . . **Nelson Thorp** writes that he and his wife just returned from the three-week trip to South and East Africa and that South Africa is really a fabulous country.

A few interesting changes of address are worth reporting because there must be some news back of them. If you who are mentioned would drop a note to me, I'll pass the word. From New York City Dr. **Morton Hecht, Jr.**, moved to 4730 Noyes St., San Diego 92109. . . . From Naperville, Ill., **John F. Keefe's** move has taken him to Penn Central Trans Co., 54 Meadow St., New Haven, Ct. 06506. . . . **Gerhand T. Feyling** has gone from Maine to Florida at Rt. 1 Box 160, Mulberry Fla. 33860. . . . **William L. Howell**, Jr., 2300 W. 1700 South, Salt Lake City 84104 used to live in Big Sandy, Tx. . . . From Alexandria, Va., to Puerto Rico is **Albert F. Sanderson, Jr.'s** move who can be reached c/o Donald Church, 2153 Collegeneral Patton, San Juan.

Biggest news of all: I have started a new company with the financial help of two associates who will be joining me in a year or two. Mass-Flex Research, Inc., is its name and we are located at 37 Whitcomb St., Waltham 02154. We are going into the manufacture of Monocoil Flexible Casing, especially for the fiber optics industry. For too long this industry has had to make do with the regular commercially available product. We plan to change all that for this growing field. I plan to be out prospecting for sales taking along my golf shoes! Hope to see many of you May 21.—**Allan Q. Mowatt**, Secretary, 61 Beaumont Ave., Newtonville, Mass. 02160

36

Graduate members of the Class have been in the news in recent months: Dr. **Charles W. Mueller**, a Fellow of R.C.A. Laboratories has received the J. J. Ebers Award of the Electron Devices Group of the I.E.E.E. "for outstanding technical contributions to electron devices, spanning the evolution of modern electronics from grid-controlled tubes through the alloy transistor, the thyristor, and M.O.S. devices to silicon vidicons and silicon storage vidicons." . . . The Bell Laboratories have been celebrating the twenty-fifth birthday of the transistor for which invention Dr. **William Shockley** shared a Nobel Prize in 1956. The actual announcement was made in June, 1948. . . . **Bill Hewlett**, President and Director of Hewlett-Packard Co., has been elected to the Board of Directors of Kaiser Foundation Hospitals and Health Plan, thus adding another organization to the list with which Bill is concerned.

Wilfred M. "Wiley" **Post, Jr.**, Manager of the Allentown Bethlehem-Easton Airport, received a 1972 Governor's Award for his role in the development of aviation in Pennsylvania. He has been associated with the A.B.E. Airport since 1937.

I regret to report that death has taken several of our classmates: **Joel B. Bulkley** in November, 1970; **Richard K. Koegler** in October, 1971; and **William K. Houghton, Jr.** in November, 1972.

Once again your Secretary will hostess a '36 picnic on June 23. Classmates in the area will receive a mailing but if any others of you are planning to be in this area at that time, we'd all be delighted to see you. President **Tony Hittl** will take on all comers at parcheesi if the weather is as uncooperative as it was last time. Do save the date and plan to come if you can.—**Alice H. Kimball**, Secretary, P. O. Box 31, West Hartland, Conn. 06091

37

Phil Peters accepted an offer from the Alumni Association to provide a room for our non-reunion Class to hold an on-campus Mini-Reunion on Sunday, June 3, 1973 before the International Buffet and the Boston Pops. This is an opportunity to renew old acquaintances and to enjoy the evening with them. If we have fewer than 30 people, Phil indicated we would like to combine with the classes of '36 and '38. Alumni Days mailings will include a block for indicating whether you plan to attend our Mini-Reunion. If you are coming to Boston, do plan to be there.

Frank M. Greene writes that he is an electronics engineer with the National Bureau of Standards, Boulder, Colo. He has been with the Bureau for 27 years and is working in electromagnetic fields and antennas. . . . **J. Robert Ferguson, Jr.**, was elected President of United States Steel's subsidiary Engineers and Consultants Inc., effective April 1. Bob moves up from Vice President and is located in Pittsburgh, Pa. . . . **Harry J. Sommer** writes that after almost 35 years he retired from Shell Development Company's Emeryville Research Center last June at which time E.R.C. was essentially closed and moved to the Houston, Texas area. . . . **Karekin G. Arabian**, Course X, also retired. I last saw Kevy Arabian in 1943 in Palermo, Sicily where he commanded a chemical warfare unit. . . . **Hjalmar D. Bruhn**, writes that in connection with his research work as Professor of Agricultural Engineering at the University of Wisconsin, he is presently engaged in studies on wet fractionation of alfalfa and aquatic vegetation for production of a protein concentrate suitable for human consumption. We wish him luck on these most important studies with international implications.

Louis D. Bloom writes from San Jose, Calif., that he is busier than ever in the technical procurement field with Breeder Reactor. January 2, 1973 was his 33rd wedding anniversary. They have two boys 23 and 30. Both are doing well. Louis writes that he has two dogs, smokes pipes and lives day by day as well as he

can, with help from his family. . . **James G. Loder** lost his second wife Alice to cancer in 1970. He remarried to Diane (McDevitt) in '71 and is starting a "third family," with 11-month-old daughter Erin Elaine, younger than any of his eight grandchildren. Commencing 31st year with Raytheon Co., on March 3, 1973. **Harry Corman** reports that his wife Betty invested in new musical *Cyrano* despite his advice to the contrary. He now is urging everyone to go. It's great.—**Lester M. Klashman**, Assistant Secretary, P.O. Box 961, Peabody, Mass. 01960; **Robert H. Thorson**, 506 Riverside Ave., Medford, Mass. 02155

38

The big news takes place shortly after you receive this. I hope you all have your reservations in for the 35th Reunion at Stratton Mountain starting Friday, June 1. I do hope to see you all there. **Don Severance** reported that he had lunch with **Dave Wadleigh** at the Energy Symposium, held at M.I.T. in February. Dave is on the M.I.T. Corporation Visiting Committee on Mechanical Engineering and earns his living as Director of Facilities Planning for Scott Paper. Don followed that with a lunch with **Bill Whitmore** who was in from Los Altos Hills, Calif., for a meeting of the Visiting Committee for Mathematics. . . . By the time you read this, I hope that **Harold Strauss** has recovered from the heart attack he had earlier this year. The only thing that I cannot figure out is since when did Harold work hard enough to get a heart attack?

Ron Smith writes, "1) Completed 25 years at Boeing, August 22, 1972. 2) Am Program Manager for SOFT Program under contract to A.B.M.D.A., U.S. Army. 3) Became Grandfather, January 1972. 4) Hobby—Sailing; have enjoyed for more than 10 years." . . . The communication from **Dan Lacock** says, "Having been retired for physical disability in 1971, have had one and a half years of pleasant idleness. Jud Judson, who works where I worked, had much to do with making my retirement a pleasant one."

I have in my grimy paw a picture of a handsome friend of mine. I am sorry that I don't live in Concord because then I could have had the privilege of voting for **Ed True** who ran for re-election as a Selectman.—**A. L. Bruneau, Jr.**, Secretary, Hurdman and Cranstoun, Penney and Co., 140 Broadway, New York, N.Y. 10005

39

Last month's lead item concerned Dr. **Harold Chestnut**'s election to the Presidency of the Institute of Electrical and Electronics Engineers. It is appropriate, therefore, to begin these Notes with a message directly from Hal himself: "This year, 1973, I will be the President of the I.E.E.E. It promises to be a very busy and interesting one. I hope it will give me a chance to meet many '39ers and other M.I.T. men and women in my travels." . . . Dr. **James Schulman**, Associate Director of Research for Materials and General Sciences for the Naval Research Laboratory, in Washington, D.C., was presented with the Navy Award for Distinguished Achievement in Science, the navy's highest scientific award. His fields include luminescent materials and phenomena, radiation-induced optical effects in solids, and the application of these effects to radiation dosimetry. He is the author or co-author of more than 90 papers and a book on these subjects, and is the holder of numerous patents.

A newspaper clipping which announced that **Wesley A. Kuhrt** has been appointed Fairfield County (Connecticut) Chairman of the "Take Stock in America" Campaign, gives us a chance to add more material to his item also in last month's column: in addition to being Division President of Sikorsky Aircraft, he is a member of the following: American Institute of Aeronautics and Astronautics, Scientific Research Society of America, and the American Association for the Advancement of Science. He is a director of the Bridgeport Hospital, Connecticut National Bank, Bridgeport Area Chamber of Commerce, American Helicopter Society, Peoples Savings Bank, and Bridgeport Manufacturers Association.

Manning C. Morrill, recently transferred by W.R. Grace and Company from his CryoVac position in South Carolina to the corporate home office, wrote enclosing two *Wall Street Journal* clippings of classmates. . . . From Portland, Ore., **Edward B. Skralskis** has retired as President and Chief Executive Officer of Omark Industries, Inc., remaining as a director. . . . **Ben W. Badenoch**, formerly Vice President of new business ventures of Sperry Rand Corp., has become President of the Airco Temescal Division, which specializes in high-vacuum electron-beam systems. Ben is now headquartered in Berkeley, Calif., and will live in Danville, near San Francisco. It is quite a change for Manny and Connie Morrill from South Carolina to Manhattan, but on the plus side, two of their daughters also reside and work in New York City. . . . Manny also spoke of **John Olsen**, still with Dewey and Almy in Cambridge, and **Brownie Parker**. As a side venture, Brownie and Manny and others from Dewey and Almy began a business venture of growing trees in New Hampshire, Vermont, and Maine. It has turned out to be a fairly sizable land-and-timber-development operation.—**Oswald Stewart**, Secretary, 3395 Green Meadow Circle, Bethlehem, Penn. 18017

40

Your Secretary received an always welcome letter from our president during our days at Tech and the first ten years thereafter, **Hap Farrell**: "**Jack Danforth** (John L.) now acting as our president should be elected as our class president —he is qualified, dedicated and has served with distinction not alone for our Class but also for the Alumni Association. I have been a poor correspondent and likewise a poor contributor to the Alumni Association for the past several years. I will try to improve in both regards as time goes on. Our Class has a real challenge to equal, or to surpass, our other so-called 'peer' classes as to donations to the M.I.T. Alumni Association by our 35th Reunion. I have lost track of what you have included in the *Tech Review* for our Class about me and our family. Let me summarize 'recent' developments: a) For the last six and one-half years, I have been with Polaroid as a senior project engineer in charge of facility and development for two major programs. Now I am presently involved with all site planning, development and related considerations such as current 'environmental' or 'ecological' problems. Enjoying the challenges. b) Alice is still 'working' with the sixth grade level of our local Weston school system as a 'Team-Aide.' c) Happer, Jr. (25 years old) is in the process of getting into business on his own or with others at Cape Cod. He served 30 months in Vietnam in the Central Highlands. d) 'Missy' (Alice Gray, age 21) graduating from college this spring and is engaged to a young man from Williams-Farm, Mass." Hap's suggestion in regard to Jack Danforth is a good one but I believe we cannot do anything until our next Reunion in 1975.

From **Charles Epstein** comes word that he is engaged in a project to derive power from winds in canyons of southern California to operate lift-pumps for the replenishment of high-level reservoirs for hydro-electric power production, wilderness fire prevention, land erosion and flood control. The electric power production will be on an experimental basis to determine feasibilty for larger scale development in southern California's mountainous regions. . . . **Norm Laschever** has been appointed Manager, Planning, for R.C.A. Aerospace System Division in Burlington, Mass. Prior to his new appointment, Norm was Chief Engineer for the Aerospace System Division. . . . **Abe Rockwood** forwarded a clipping from a Florida newspaper describing the activities of the **Jorge Echarte Jr.** family. The article discusses how the family left Cuba after the coming of the Castro regime and started from scratch to develop land in the Ft. Lauderdale area of Florida. Abe notes: that the clipping was forwarded by his mother-in-law and says: "I had told her of Jorge Echarte's work down there earlier, and at that time she already knew of his projects—it's a small world. Other than that, there is little to tell you. I've completed 25 years with Maurice Reidy Engineers, and just recently had the pleasure of seeing a Filene's (department store) addition in Boston go up in accordance with our plans."

It is with regret that I must report the death of **Julius Molnar** at 56 years of age who received his doctorate in Course VIII. At the time of his death, he was Executive Vice President of Bell Labs and member of the Board of Directors of Bell Labs and the Sandia Corp. Julius joined the technical staff of Bell Labs in 1945 and was initially concerned with research in physical electronics and the development of microwave tubes. In 1955 he was appointed Director of Electron Tube Development and in 1957 he became Director of Military Systems Development. Julius became President of Sandia Corp.,

and a Vice President of the Western Electric Co., in 1958. He returned to Bell Labs in 1960 as Executive Vice President.

James Fisk, President of Bell Labs stated: "Julius Molnar was the principal architect of our systems development programs. A man of great talent, of unmatched energy and drive, a perfectionist—he was totally dedicated to Bell Labs. For the numerous accomplishments that can be attributed to Bell Labs in this past decade, a large share of the credit belongs directly to Julius Molnar."

In describing Julius, Kenneth G. McKay, Vice President of engineering, A.T.&T., said, "an inquiring mind, an insatiable appetite of facts, a powerful desire to see things happen, an inherent ability for leadership; these are some of the attributes that made him extraordinary. Under his firm hand, an unprecedented development program evolved during the past decade at Bell Labs. Its results will be felt for decades. His influence and leadership permeated that effort. We have lost a great technical leader." Julius also worked very closely for a period of 15 years with the Atomic Energy Commission and the Department of Defense. He was the inventor of a number of patents, in the fields of high frequency electron tubes and oscillators, and is the author of many technical articles. In addition, he was on the Committee of Science and Technology of the U.S. Chamber of Commerce, a Fellow of I.E.E.E. and the American Physical Society, and was a member of the National Academy of Engineering and the American Optical Society. In 1971 he received the George Washington Award of the American Hungarian Studies Foundation. He is survived by his widow the former Margaret Andrews, and his son, Peter. Please write to **Al Guttag**, Secretary; Cushman, Darby and Cushman, 1801 K St., N.W., Washington, D.C. 20006

42

Ed Vetter had been elected Executive Vice President and Chief Financial Officer of Texas Instruments. He writes that his mechanical engineering skills have become particularly useful in repairing fences on the Vetter cattle ranch North of Dallas. . . . **Russ Estelle** is still with the Neptune Meter Co., but has moved from New Jersey to Indianapolis. Russ' daughter is doing research at the local V.A. Hospital and his son is a freshman at Drexel Institute.

Bill Hendrich came through with a cryptic message "I am alive and well with a temperature outside of —20°Farenheit." The equally cryptic post mark gives no clue about Bill's actual location. We would certainly be interested in hearing what he is doing and where he is located in the cold belt.

Really not much news this month. Let us hear from you all in time for the next issue.—**Ken Rosett**, Secretary, 191 Albemarle Rd., White Plains, N.Y. 10605

43

Two quick thoughts come to mind on this rainy St. Pat's Day. First, the instructions say something about "43 characters per line" . . . and my thought is: '43 sure has its characters! Second, the paper is green and it's the "Wearin' of the Green Day." So I say, "May trouble follow you all for the rest of your life . . . and never catch up." Speaking of catch-up, let's go!

Here's a letter I just received from **Richard M. Stern**. He writes, "I have just stepped away from a 27-year association with our formerly family-owned business, now STERNDENT (an American Stock Exchange firm in precious metals, electric contacts and dental equipment and supplies) into the arena of product development and idea exploitation in items of an electrical or mechanical nature. This new venture is on a free-wheeling basis in direction and in its conceptual nature. Participation by others could be in furnishing an idea, prototype engineering, product design or financing, compensated when possible on a contingency basis. This type of relationship might appeal to students, faculty members, moonlighters, or just plain frustrated inventors. Any wild ideas from the Class of '43 would be more than welcome."

If you want to inquire further of our classmate, his address is: 6 Forbes Blvd., Eastchester, New York, 10709. Here's hoping you can get your "old teeth" sunk into this new activity, Dick.

Working backwards, the next-to-last letter I received was late last year from **Christian J. Mathew** in San Francisco. He writes with such accomplished style that I would like to recommend him to you brothers for "Class Secretary of the next decade." Anyway, Chris' account follows: "It is at a time like this that I realize being in the hospital business has isolated me from many of my past activities and friends. I was involved in planning a $32 million new hospital. Today the construction is well underway and we are now planning an $8-$10 million Professional Office Building addition.

"I had the pleasure of visiting with my old friend **Harold Weiss**, Course II in St. Louis during the past year. I celebrated my 50th birthday this year and our six youngsters got together and presented me with personalized number plates for my car. I am driving around the State of California with M.I.T. '43 on front and back of the car. I found myself trapped between being modest and being a good father and graciously accepted the gift."

Now, digging even deeper into my backlog, I publish portions of a letter from **Stan Proctor** which arrived here last autumn in response to my request for news. Your Secretary appreciates your interest, Stan, and your account is still timely. "Dear Jack,: Briefly, the years since graduation have been extremely happy and fruitful. In 1955 I started my own business, specializing in hydraulic and pneumatic equipment, and today we are among the largest distributors of hydraulic and pneumatic equipment in the country. As the company has grown and our organization has matured, I have been able to spend a considerable amount of my time in educational pursuits. My prime interest, of course, is M.I.T. I have served as Chairman of the Educational Council for the Cleveland area for 10 years, a past President of the local M.I.T. Club, a Director of the Alumni Association, and more recently, a member of the Corporation Development Committee. This year I will act as Deputy Chairman at the A.O.C. Conference which will be held in Cambridge in October. In March '73, my wife and I will attend the 30th Annual Fiesta in Mexico.

"In addition to my M.I.T. activities, I am on the Development Board of Hiram College. I have actively served Case Western Reserve University as a special lecturer in the field of marketing and I have also been interested in many areas involving independent education. My wife, Lois, has also taken her place in the community and is an active Reader for the Society of the Blind and is one of the few accredited Readers for the Library of Congress."

A release from The Institute of Electrical and Electronic Engineers brings news that **Robert C. Fletcher**, who lives in nearby North Plainfield, has been elected a Fellow of the Institute "for research on microwave beam devices and spin and cyclotron resonances in silicon, and for technical leadership in the development of solid-state devices." Our classmate is Executive Director of the Integrated Circuits Development Division at Bell Labs, Murray Hill, N.J. . . . **Edward R. Kane**, a Senior Vice President of E.I. du Pont de Nemours and Co., who took his doctorate with our Class, was the moderator for a panel discussion of the M.C.A. late last year with the provocative title, "Industrial Research—A Changing Ball Game." . . . Another release of '72 vintage announced that **George W. Bartlett** "has been appointed President of the Neway Division, Lear Siegler, Inc." This firm, headquartered in Muskegon, Mich., designs and manufactures air suspension systems for trucks, trailers and tractors. George is active in Junior Achievement, United Fund, and other organizations.

The M.I.T. Club of New York threw one into the '43 hopper last autumn with the word that **Ward Haas** was "now a Vice President of S.C. Johnson and Son, Inc., of Racine, Wisc., in charge of Corporate Research and Development." The old mail bag here, Ward, will "wax full" waiting to hear from you . . . or will you surprise me? . . . Another release of awhile back tells us that "the Trustees of Columbia University have announced the creation of three professional chairs at the College of Physicians and Surgeons." One is the Dickinson Richards Chair in Medicine and our classmate, Dr. **Harry W. Fritts, Jr.**, is the first incumbent. The professorship was established by Columbia through a generous gift of the Merck Company Foundation to honor the co-winner of the 1956 Nobel Prize in Medicine. . . . An article in the Chronicle Citizen of Brookline, Mass., last year end told us that the Board of Selectmen had appointed **Eugene R. Eisenberg** to the local Building Commission. A member of the Boston engineering firm of Linenthal-Eisenberg-Anderson, Inc. since 1965, our classmate is also on the faculty at Harvard Graduate School of Design.

The in-house press of MITRE Corp.,

Bedford, Mass., carried the news recently that **Richard S. Fallows** has become Head of D-61, Surveillance and Controls Systems Department. Since coming to MITRE in 1958, Dick has worked on design evaluation, test planning and implementation tests of air defense systems. . . . **Wilbur B. Davenport, Jr.**, Associate Head of the Department of Electrical Engineering at Tech has been appointed Director of M.I.T.'s Center for Advanced Engineering Study and will serve in that capacity as Professor of Engineering. He will also serve as a member of the M.I.T. Engineering Council.

Hans J. Haac says bluntly, "Awaiting plans for 30th Reunion!" So am I. . . . **Tom Harrison** relays a message mainly to Pete Gratiot, ". . . we finally developed a real-time display that didn't make people seasick. Olympic scoreboards in the main stadium at Munich last summer. But I had to move to Fairfield County, Conn. to do it." . . . **William M. Rowe** writes, "Retired January '72 from Commerce Department, N.O.A.A.-National Weather Service after over 34 years of service." Good luck, Bill, but 34 years, you say? Were you moon-lighting when the rest of us were studying frosh physics?

Dr. **James P. Craft, Jr.**, tells us that he "delivered a paper, 'Cybernetic Models, Human and National Decision-Making Processes' last autumn at the annual meeting of the Northeastern Political Science Association at Amherst, Mass." That must have been a hum-dinger, Jim and, tell me, aren't our national decisions being made by humans these days? . . . **John E. Ward** says, "Have continued to be active in Cable Television. Presented a paper 'What Belongs on the Cable' at the National Cable Television Association's annual convention in Chicago last summer." . . . **Bill Vallette** pens the cryptic note,"Elected to Executive Committee, National Council on Industrial Engineering for a two-year term." Can we expect a report from you soon, Bill? Congratulations! . . . Hey, here's one from Pancho "South-of-the-Border" **Robert H. Handler** who says, it seems sadly, "Marie and I are back in New Jersey after four years in Mexico City. Still with R.C.A.—now as Manager of Manufacturing Planning in Harrison, N.J. All three kids are graduated and married and all live in Ohio." Say, neighbor, c'mon down 'n see me sometime!

Dr. **Marjorie K. Smith** writes that she is "still busy training school physicians for the New York City Department of Health, holding a number of P.H. pediatric clinics, assisting in Cornell Medical Nursing Associate Program. Orient summer 1971, Spain 1972." You should use a few more words, Docta Marge! Your note reads like a prescription! But, thanks a heap. . . . **W. M. Laird** flashes one, "Have moved to Bradford, Pa., where I am again teaching for the University of Pittsburgh at their Bradford (regional) campus. We have about 600 students and offer the first two years of university courses. The campus will be expanded to about 1500 students, and eventually may become a four-year program. Looking forward to 30th Reunion." Good show, Bill. . . . Classmate **Melvin Lax** says "Was appointed Distinguished Professor of Physics at City College of New York on September, 1971 after many years at Bell Telephone Labs in New Jersey." That's a long time between connections to your Class Secretary, too, Mel.

Bill Voorhies sends a new address only: Consultant—Components Div., General Instruments Corp., 600 W. John St., Hicksville, N.Y. . . . And finally, the "I wrote my life history on the head of a pin award" goes to **Norman J. Gordon** whose 2000-word account is now being deciphered at Palomar Observatory, Mount Wilson, Calif. Next time, okay!

Fullstop but don't stop reading. It is appropriate for yours truly to let you all know that "I hereby resign from this post, effective with our 30th Reunion this June." It has been fun, but a bit lonesome at times. No kidding, friends, I am bowing out. Unfortunately, I will not be present at the 30th, so, no speeches, please, about my great services. Like "The General" said . . . General Sherman, I think it was . . . "If elected, I will not serve!" It's been fun, but I have news for you: Class Secretaries don't live longer, it just *seems* longer!—**Jack Kelly**, 34 Scudder Rd., Westfield, N.J. 07090

44

Henry Cohen has been appointed to the new rank of Dean of the Center for New York City Affairs at the New School for Social Research. The School President said, "Dean Cohen has ably guided the Center's development to its present position as a leading institution for the study of complex urban problems." In his extensive experience in city government, Dean Cohen played a leading role in handling critical problems relating to health, social welfare, and city planning. He was formerly Deputy City Administrator and First Deputy Administrator for the Human Resources Administration. Dean Cohen resides in Manhattan (naturally) and is married to the former Evelyn Fuhrman, a psychiatric social worker, and has two children, Alison, 22, and Daniel, 17.

According to the *Fall River Herald News*, **Egilda (DeAmicis) Witherell**, is a key leader at the Newton-Wellesley Hospital where she is the Resident Radiological Physicist. A former member of the M.I.T. Radiation Laboratory, she did pioneer work at the New England Deaconess Hospital in medical radiation and set up a course for the physicians. Under her guidance, the Newton Hospital has earned a perfect score on safety from the A.E.C. She and her husband, an accountant, make their home in Needham. Eastman Kodak has elected a new Assistant Vice President, **Anthony Frothingham**. He was General Manager of the motion picture and education markets division. Starting in the training department in 1948, Tony moved up in sales, mostly in the international division in Paris. A native of London, he now lives at 91 Fairway Crescent, Irondequoit, N.Y. . . . In a different field entirely, **Joseph L. Kaufman**, has been appointed to the Board of the American Stock Exchange. Joe is President of Cohn, Delaire, and Kaufman and has been affiliated with the Amex since 1956. He started as a stock specialist and became a governor in 1965 where he served as a director of the Exchange's Clearing Corp. Mr. Kaufman resides in Manhattan with his wife and two children.

Just a short note from **Kay A. Kulmala** stating, "Sitting on a local planning board, I feel considerably less inactive than sitting with it! But also see how they need the paid time of planning consultants." . . . **Howard Lockwood** is spending a sabbatical year in Israel as an exploratory means of deciding whether or not he wants to eventually settle there. He is currently learning the Hebrew language and is investigating business opportunities.

Dr. **Andrew M. Margileth** reports that he is a new member of the American Pediatric Society. . . . I was pleased to learn that **Arturo M. Morales** won the best technical presentation award last year from the Mexican Mining Engineering Institute. It was an international competition and Art won a trip to Europe to the International Mining Congress at Bucharest.

The Burlington Free Press ran an article about **Robert Oppenlander**, who was speaking to the Rotary and Lions Clubs. Bob is Senior Vice President—Finance and Treasurer for Delta Air Lines. How did a good engineer fall by the wayside and end up in finance? Well, he got an M.B.A. from you-know-where. He joined Delta in 1958 and moved up to Comptroller and Treasurer in 1960, then became a Director in 1968. . . . Another note from **Arthur F. Peterson** regarding his new career in labor relations. His engineering education is proving of value because the best decisions are unemotional, objective, and hopefully logical. . . . I.C.I. North America Limited has announced the election of **Robert J. Reilly**, as Vice President-Finance (another one). He is also Vice President of I.C.I. America Inc., which is a subsidiary of Imperial Chemical Industries Limited (I.C.I.) of London. Got that?

Mr. Reilly joined Atlas Chemical in 1953 prior to its acquisition by I.C.I. in 1971. At Atlas, he rose to become Vice President and Treasurer. Earlier he was with the Atlantic Refining Co., and moved into the finance field via an M.B.A. from Pennsylvania. Bob is a director of the Delaware Trust Co., and the Equity Growth Fund of America, Inc., as well as being a member of a number, of civic, social, and business organizations.

Clifford A. Spohn reports he is currently Director, Office of Operations, National Environmental Satellite Service, National Oceanic and Atmospheric Administration. (That's as bad as the I.C.I. titles.) Cliff joined N.E.S.S. six years ago after retiring from the U.S.A.F. after 25 years. . . . Finally, a note from another man at I.C.I.: **James A. Weaver**. He is Director of Corporate Planning and Appraisal for I.C.I.-America and commuted to England five times last year. He also was with Atlas prior to its acquisition by I.C.I. On the side he plays clarinet in a Dixieland jazz band.—**J. G. Barmby**, Secretary, U.S. General Accounting Office, Washington, D.C. 20548

45

Our apology for missing the March-April issue; unfortunately, your Secretary was laid low with bursitis in the right shoulder at the time Notes were due. Yes, I know old age; you will next be accusing me of senility!

The February 1 issue of the Bristol (R.I.) *Phoenix* reported that Ann Street, a well known Narragansett Bay sailor, was to be navigator aboard a new Skip Etchells' designed 46-foot-sloop during February S.O.R.C. The article went on to say in passing, that Ann's father, **Chick Street**, might be permitted to crew. Yes, another example of the younger generation taking the reins! . . . **John Morrison**, after taking his Ph.D. in Education last June, serves Glassboro State College in southern New Jersey as Director of Continuing Education.

Dr. Richard H. Batlin has a 50 per cent interest in the $10,000 American Institute of Aeronautics and Astronautics' Louis W. Hill Space Transportation Award for 1972. Dick, along with Dave Hoag '47, has been involved with Stark Draper's Apollo program since 1961. The award is for "significant contributions indicative of American enterprise and ingenuity in the art and science of space flight". . . . **Freida Omansky** Cohen reports that she now has a daughter-in-law at Tech; Edith is a graduate student in the Department of Nutrition. . . . **Tom Gurley** moved from Washington, D.C. to Los Angeles in 1971 to become Project Manager for the D.D.963 with Litton Ship Systems in Culver City. Tom liked California so well that he did not relocate with Litton to Pascagoula, Miss., but stayed on to become Manager, Systems Engineering and General Manager with Atek Industries, a small company engaged in Water Pollution Control.

Alvin S. Cohen was recently elected Group Senior Vice President of Campus Sweater and Sportswear. Al reports that daughter, Nancy, was married to Dave Miller, a graduate student at George Washington Union, while we understand son, Mark, is finishing his junior year at the Institute. . . . Many of you will recall our **Emily** "Paddy" **Wade**'s comments late last year. Paddy's zoo reports indicate that a new bird complex will open this summer, while the proposed African building is aimed for 1976—our bicentennial year. . . . Now and again, one of our comments provokes an answer! **Bill Blitzer** no longer races a Rhodes 19 (my class!), but now races an Etchells 22, one of Long Island Sound's hot classes.

During our January 4 Alumni Fund Telethon, your callers—**Bill Shuman**, **Bill McKay**, **Gerry Quinnan**, and I reached 60 classmates in our effort to beat the drum. On the subject of drumbeating, Mr. and Mrs. Quinnan, **Chuck Patterson**, **Charlie Hart**, **Frank Gallagher**, **Springer**, **McNamara**, and **Shuman** will be celebrating a 45th mini in Spain, March 30 through April 7. Yes, I'll be sure to spin a few tall yarns next month. Speaking of mini reunions, don't forget the one Sunday, June 3, prior to Boston Pops. During the aforementioned Telethon, we did pick up the following tidbits. After 18 glorious years in Jersey, Don and **Pete Hickey** still consider Harwichport on Cape Cod as home; Pete is with Seaton Leather Co., in Newark. . . . **Jake Freiberger** is up to his ears in real estate; i.e. besides the old laundry business, mini warehouse construction, and operations in Houston, Dallas, Fort Worth, and Atlanta. Jake's hobby or diversion at the moment is sailing. . . . **Guy Gilliland** hoped to attend the 25th Fiesta in Mexico City in mid March; one kid, or is it young adult in prep school, with a daughter at Emory in Atlanta. . . . **Sara Street** lives on Marlboro St., in Boston with a big interest in dance and the theatre. . . . **Maxie Richmond** has been International Sales Manager of General Foods Baker Cocoanut operation for the past three years.

The **Jim Levitans** plan to be in England in June. . . . **Sandy Neuhaus** gave us a good rundown on Torremolinos as he was there on business in '66. . . . **H. Paul Grant**'s wife, Marion reports that the old radical (you all remember his *Voo Doo* stones and antics) has become a staunch conservative! Lib and **Jerry Patterson**'s oldest, graduates from S.M.U. Law School this Spring—Mark Patterson has served his duty as a conscientious objector, while Rob is a sophomore at Colgate. If memory serves me correctly, Elizabeth should be a freshman in High School. . . . Ellen and **Jim Brayton** should have been skiing with son, Dana, the week we were in Spain.

That's it—see you in June.—**Clinton H. Springer**, P.O. Box 288, New Castle, N.H. 03854

46

Sterling S. Bushnell has returned to the U.S.A. after a two year tour in England where he set up an affiliate of his American Company. Sterling is sure the new company in England will be successful but is glad to be back and to be in the same house. Reports he is Americanized again except for the cold and snow.

Donald E. Burke has written a nice note on his alumni contribution envelope from his home in Florida. He is still busy as a municipal financial consultant with Reynolds Securities, Inc. They are involved in financing the anti-pollution facilities for various public bodies. The shortage of low sulfur oil and natural gas are problems for the power aspects of municipal financing. Don took his wife and family of four (20, 18, 16 and 12) on a summer vacation trip to Africa. They saw the whole continent (briefly as you might imagine) but the natives were friendly everywhere.

We are privileged to state the following reports were gathered from the 25th Reunion book. After graduation in 1946, **Samuel Gusman** returned to M.I.T. to obtain a master's degree (Course X) and several years at Brown led to a Ph.D. in Physical Chemistry. Sam was married after leaving M.I.T. and they moved to Philadelphia after graduation from Brown. Sam joined Rohm and Haas in chemical research and after a group of research and management assignments Sam, Carolyn and their two sons moved to Columbus, Ohio. His work here was with Warren-Teed Pharmaceuticals, a Rohm and Haas subsidiary, again in general and research management. Sam is now President of Warren-Teed, Inc. The Gusmans have one boy, John, at Michigan State University and David, who is in high school.

Richard L. Ballman joined Firestone Tire following graduation and two years later left for Monsanto Co., at the Plastics Division Research Department in Springfield, Mass. Dick worked on various polymer product projects but became more interested in fundamental research and polymer rheology. This led to his appointment as a Science Fellow in 1965. In 1970 Dick transferred to the Textile Division of Monsanto and the Ballman family moved from Springfield to Pensacola, Fla. Dick and his wife, Jane, a graduate of the University of Maine, and three daughters and one son live in Gulf Breeze, Fla. . . . A brief note from **Dave Sherrick** reports his son, Bob, has entered M.I.T.

Until the next time.—**Russell K. Dostal**, Secretary, 18837 Palm Circle, Cleveland, Oh. 44126

47

Gina, the children, and I have just returned from a week of skiing in Vail so everything looks a bit brighter. The mail is rather thin so will include a few autobiographies from the 25-year Reunion so that you who couldn't attend will be able to find out about those who did.

John Bender was just promoted to Manager of Marketing for Ordnance Equipment Programs by General Electric in Pittsfield, Mass. John received his degree in Management here. He married Mary Jane Wick (Kansas State U.) and he and Mary have three children, aged 20, 24, and 26. John was President of his Kiwanis chapter in 1970, and says he spends his leisure time either skiing or working in his greenhouse.

John continues, "After graduation from M.I.T. in Course XV, my family of two babies, my wife and myself returned to Kansas where I taught for two years at Kansas State University. In 1949, I served as Industrial Representative for the Topeka Chamber of Commerce until I was recalled to the Air Material Command during the Korean War serving at Servel, Ind., Evansville, Ind., (1950) and Ford Aircraft in Kansas City, Mo., (1951). Upon release from the air force, I returned to Topeka to join American Overhead Door Co., and became its President. In 1960, General Electric Co. brought us to the Berkshire Hills.

Our oldest daughter, Barcley, Wellesley College, '68, married Bill, Harvard Business School grad. They live and work in New York City. Pam graduated from University of Connecticut and married Ted, a Brown graduate in engineering. They are in Albuquerque, N.M. Sue is a junior at Wheaton College. My wife, Mary Jane, is going in as President of Berkshire Medical Center Auxiliary and is on four other civic boards.

Hugh Lavery writes that he has been with International Paper since graduation, working primarily in manufacturing from

process control through development and has found it most rewarding. He is now in Corinth, N.Y., and has a son at M.I.T. Course X class of '73. . . . **Jim Justice** transferred his consulting business from Washington, D.C. to Dallas in 1971. He then assumed full time responsibility as Chairman of the board and chief executive office of the Harding Oil Co., a petroleum exploration and development company.

More from the Reunion booklet: **Harl P. Aldrich, Jr.**, 91 Rollingwood Lane, Concord, Mass. 01742. Harl is President of Haley and Aldrich, Inc., Consulting Soil Engineers. He received the S.B., Course I, '47; Sc.D., Course I, '51. His wife is Lois A. Grissel, whom he married in 1946. She received her B.A. '44 and M.A. '46 from the University of Iowa. They have five children. Harl is a Registered Professional Engineer in Massachusetts Societies: Sigma Xi; Tau Beta Pi; Chi Epsilon; American Society of Civil Engineers (President, Massachusetts Section 1964); Boston Society of Civil Engineers (President, 1968-1969); A.S.T.M.; American Institute of Consulting Engineers; Consulting Engineers Council. Harl writes, "Graduation from M.I.T. in Course I brought no immediate change of scene for me since I stayed on at Tech for ten more years and at Westgate for five! During and following my graduate studies, I was associated with M.I.T. in the positions of Teaching Assistant, Instructor of Soil Mechanics and Assistant Professor of Soil Mechanics. I also served as Executive Officer of the Department of Civil and Sanitary Engineering (1955-1957) and was Visiting Lecturer on Soil Mechanics at Harvard (1955-1956).

"In 1957, I left M.I.T. and joined James F. Haley to found the consulting firm of H. and A. with offices and laboratory in Kendall Square. We presently employ about 60 professional, technical and office personnel. Our local projects include the Boston Company Building, Keystone Building, One Beacon St., the Christian Science Church Center, Harbor Towers, Technology Square, and M.I.T. Eastgate.

Our experience has expanded to include nearly 3000 projects throughout the U.S. and the world. On the home front, this 25th Reunion will neatly round out our family-raising years, as our youngest child graduates from high school the night of the Reunion banquet. Kay graduated from University of Massachusetts in 1969, was married the following week and left within the month for two years in the Peace Corps in Kenya. She and husband Edward Toth are now back for graduate work. Harl III (Hap) received his degree from Tufts in religion last June, was married in July to Ruth B. Burnham, Jackson '72, and plans to go on for further training in social work. Barbara, after two years at William Smith College and assorted courses at Northeastern, will enter the Columbia University School of Nursing in September. Jean is a freshman at Carnegie-Mellon University, a B.F.A. candidate in Drama, and Kent will matriculate at Cornell, College of Engineering in the fall."

Until next month, drop a line.—**Dick O'Donnell**, Secretary, 28516 Lincoln Rd., Bay Village, Ohio 44140

48

The Reunion Committee has mailed a request for biographical and statistical information to all classmates. If you have completed your autobiography and filled in your questionnaire and have mailed them to the committee—thanks for your prompt cooperation. In 1958, 800 classmates returned their autobiography.

A brochure describing the Reunion was sent to you March 19. Beginning Thursday night June 1 with registration and a series of House Parties in the Boston area, the Reunion continues on Friday at the Essex Country Club with bus transportation provided. On Saturday, the faculty luncheon, discussions, and cocktails at President Wiesner's will provide an opportunity to interact with M.I.T. today. Sunday morning after church, information for self-guided tours of the campus and the Boston area will be available. Arthur Fiedler will conduct the Boston Pops Orchestra on Sunday night during Tech Nite at the Pops. On Monday, the program is provided by the Alumni Homecoming Day Committee on campus.

A change of address list of classmates (as up-to-date as possible considering the ten to 20 address changes per month) was mailed. I hope you will write your friends and invite them to join you at the Reunion. Reunions are fun when you meet old friends, or make new friends with common interests. To help rekindle old friendships, members of fraternities and dormitories are asked to write to others in their living group inviting them to the Reunion.

On February 2, '48ers in the greater San Francisco area met at the University Club for cocktails and dinner. They reminisced, talked about the Reunion and the gift, and generally caught up on each other's doings. Attending were: Marie Louise and **Art Aronsen**, **Steve Davenport**, Phyllis and **Ron Kallman**, Mary Ann and **Phil Lally**, Mary and **Rus Lawton**, Susan and **Den McNear**, **Fred Naber**, **John North**, J. and **Duane Rodger**, and **Ken Brock**. These alumni represent about 20 per cent of the alumni in the area—if 20 per cent of the Class comes to the June Reunion, we will break the Institute's seams.

Ken Brock has been promoted and has moved into M.I.T.'s administrative staff where he has assumed new responsibilities in M.I.T.'s development organization. Ken has been Director of the M.I.T. Alumni Fund, and will become Director of Resource Operations, with primary responsibility for coordination of the staff, carrying out a variety of funding objectives, and strengthening liaison with the Alumni Fund and the Alumni Association officers and staff. In this capacity, Ken will have general operational responsibility for continuing interactions between the Institute staff and various funding prospects.

William R. Zimmerman, President and Chief Executive Officer of Swedlow, Inc., has been elected to the Board of Directors of Trust Company of the West. The company specializes in fiduciary asset management for substantial tax-exempt accounts. Bill is also a director of State Mutual Savings and Loan and Far West Financial Corp. . . . The number of letters plus the personal notes written on the inserts of envelopes containing gifts to the Alumni Fund totaled ten items this month. If this continues for a full year, it will result in mail communication with 10 per cent of the Class. . . . **Marshall Dick** wrote that he is a program manager for the Industrial Pollution Control Section of the Environmental Protection Agency. Marshall and Kathy's 8-month-old son Jonathan is their pride and joy. To my knowledge, among all our classmates, Marshall and Kathy are the parents with the youngest child.

James T. Smith was recently promoted to Vice-President and General Manager of the Fort Wayne Division of the Magnavox Company. . . . **Buckley Collins** is serving his fourth term (since 1965) as a Councilman of Port Huron. Buckley was President, Blue Water Chapter, Michigan Society of Professional Engineers in 1971-72. . . . **Carl Petersen** and his wife and their sons Scott and Mark moved from Brussels, Belgium to England. Carl is Operations and Supply Manager for Chevron Oil (U.K.), Ltd. . . . **Macey Feingold** is President of a consulting firm and lectures in nutrition. . . . **Carl Blake** writes from Kwajalein in the Marshall Islands. Carl is Site Manager of the M.I.T. Lincoln Lab Kiernan Reentry Measurements Site. Carl and his wife live on the island with their two youngest daughters. Two older daughters attend Lesley College in Cambridge.

Mary Montgomery wrote from Newport News, Va., that she has switched from teaching mentally retarded children to teaching children with learning disabilities. Six years ago, Mary earned a master's degree in Special Education-mentally retarded. Certification requirements in Mary's new field required an additional 21 hours and Mary is back in grad school at William and Mary in the evening. Mary has five children in college and high school. Although her job will prevent her from attending our 25th Reunion, Mary hopes it will be a big success! . . . **Al Carr** is studying for a master's degree in Business Administration at Loyola College in Baltimore. After the first course, Al began to get used to the regimen, but it does take a good deal of study time.

Norb Andres wrote that he and Pauline make regular visits to Boston and New York City from their home in New Hartford, N.Y. Their oldest daughter is considering attending Brown University next year. Norb and Pauline had hoped that at least part of the 25th Reunion would be in Bermuda. . . .**Bob Cadieu** wrote that the death of his wife, Mary, in October 1972, has been the big change in his life. Our sympathy is extended to Bob.—**S. Martin Billett**, Secretary, 16 Greenwood Ave., Barrington, R.I. 02806

49

Once again our Class will hold a cocktail party in connection with Alumni Day. Sunday, June 3, from 5:00 to 6:00 p.m. is the time. "Mini-Reunion" is the name, and we will be joined by all other non-reunion classes, under the overall sponsorship

of the Alumni Association. **Pete Cambourelis** is in charge for '49. If we have 30 or more people attending, there will be a private bar. If fewer, we will share facilities with one or more adjacent classes. Cost? $3 per person, including drinks and snacks. Y'all come, you hear?

Jack Fogarty's annual Christmas letter has arrived. Herewith, some excerpts: "It's been a busy year and we're still very happy that we moved to Columbia. It's an exciting place and we're beginning to take part in some of the many activities offered here. Every third Saturday we bash bottles at the Recycling Center, and we're helping to support a small Quaker group which is beginning to become active. We're also vitally interested in a psychic research group which meets every other Wednesday night.

"The Electro-Physics Laboratory is doing well. They're running a long-term ionospheric research experiment within the auroral zone in northern Canada and are working overtime to develop an over-the-horizon H.F. radar for installation at their Virginia test site. Jack decided against continuing his graduate work at Johns Hopkins this year in favor of home writing and has produced a small book on radar signal processing for internal use at E.P.L. Columbia has extended its bike path network so Jack has a parkland ride now for fully half of his bicycle route to work—used a couple of times a week."

Dave Hardin sends in "one last promotion," enclosing a letter to the stockholders from Market Facts, Inc., noting that David K. Hardin, formerly President, has been elected Chairman of the Board and Chief Executive Officer. Congratulations Dave. . . . A letter from **Dick Fleischer** encloses an announcement that he has joined Fenvessy Associates, Inc., publishing and mail order consultants, in New York City, as Vice President in charge of the firm's data processing consulting activities. He was formerly a manager in the Management Consulting Division of Peat, Mitchell and Co.

From Alumni Fund envelopes, we learned that **Milt Bevington** was again a father last April when his seventh son, eighth child, Justin Leyden, was born. "Congratulations" is still the right word. . . . **George Latimer** reports that he has returned to Michigan to become General Manager, Transportation Systems Operations, for the Ford Motor Co., after five years in England with Ford of Europe. . . . **Don Botway** writes, "Since forming Roytran International Corp., less than a year ago, I have really been on the run. We act as U.S. sales agents for a number of British companies."

An article in the Providence, R.I., *Journal* reports that **Louis G. Peloubet** now has the title Vice President-Controller with Textron Inc. Lou was Assistant Corporate Controller of Allied Chemical Corp. in New York before joining Textron last April. He is now a C.P.A. with a master's in finance and accounting from the New York University. . . . Finally, your Secretary announces that Sonya and I will be living in Brazil for several months later this year. We will also spend the month of April there. All this in connection with work Arthur D. Little is doing with C.S.N., a large Brazilian steel company. If future columns begin to be mottled with Portuguese terms, you'll know why. Best wishes to all.—**Frank T. Hulswit**, Secretary, c/o Arthur D. Little, Inc., Acorn Park, Cambridge, Mass. 02140

50

John J. McHugh is a Pathologist at Mercy Hospital in Toledo, Ohio. John has been there for over seven years. . . . **Gerald L. Robinson** received a Ph.D. in industrial engineering from the Ohio State University in March, 1972. Dr. Robinson has been appointed group leader for educational systems in the Social and Systems Sciences Section of Battelle Memorial Institute, Columbus Laboratories Division. He heads a research team that conducts studies in educational technology, educational planning and management, and educational systems analysis.

Joseph S. Gottlieb is Chief Engineer and Manager of Mechanical Construction on the Greenpoint Medical Center project for Walsh Construction Co., Brooklyn, N.Y. Besides growing kids and an obese but affectionate cat, Joe and Vera report exciting vistas and beautiful crafts found in Indian back country in Arizona and New Mexico this past summer. . . . Professor **Peter Gutmann** is the new Chairman of the Department of Economics and Finance at the Bernard Baruch College of the City University of New York. . . . On March 30, 1972, **Myles S. Spector** was elected President and Director of Seaboard American Corp. (Public—O.T.C.), of Flemington, N.J., and became major stockholder. It is a medium-size diversified company in the food and housing fields. Myles is busy turning it to a solid profitable base and looking for suitable acquisitions.

Walter Jones announces the relocation of his architectural office to new expanded quarters at 419 Boylston St., Boston, Mass., 02116. . . . **Donald W. Ramsey** announces the birth of a new daughter, Christine Ellen, born November 26, 1972. Christine Ellen joins Laura Lynn, 7, and Robert Bruce, 5. Don continues as Project Engineer at Rochester Products Div., General Motors, designing carburetor tests, with added responsibility for product safety, patent, and legal investigations. He also continues as Town Justice for the Town of Chili. . . . The cosmetic division of The Risdon Manufacturing Co., of Bridgeport, Conn. has named **Jack P. DeWitt** of Norwalk as Senior Production Engineer. Jack was Producibility Manager for Winchester Electronics and Advanced Manufacturing Engineering Manager for the Burndy Corp. He is married and has two children.

Robert W. Mann has had a change of appointment to M.I.T. Professor of Engineering in the School of Engineering, and Chairman of the Executive Committee, Division of Health Sciences and Technology from Professor of Mechanical Engineering beginning July 1, 1972. . . . **Jack A. Arnow** is now President of Interactive Data Corp., in Waltham, Mass. Jack was previously founder and President of Computer Communications Center, which has since merged into I.D.C. He has also directed the operation of Lincoln Laboratory's computer center.—**John T. McKenna, Jr.**, Secretary, 2 Francis Kelley Rd., Bedford, Mass. 01730

51

Maurice S. Hedaya wants everyone to know he's only 40 years old and the grandfather of a new baby girl. . . . From the *Wall Street Journal* we learned that **Albert L. Zesiger** is President of B.E.A. Associates, Inc., which manages some $325 million worth of private and pension accounts. Last summer he predicted that the market average would climb above 1000 by late 1972, and he was right! . . . At M.I.T., **William T. Peake** has been promoted to Professor in Course VI/E.E., and according to the "American Metal Market," Professor **Mert C. Flemings**, along with two other researchers, discovered three new casting processes: rheocasting, thixocasting, and compocasting (Rheo-, Thiox-, and Compo- sounds like a Marx Brothers' casting (pun)). . . . In the petroleum industry, **David R. Esty** transferred over to the Iranian Oil Operating Companies in Teheran as Head of Technical Services after a nine-year stint with Jersey Standard's Esso Libya. . . . From Wilmington, **David H. Carleton's** architectural firm has been at it for five years now and doing well; mostly institutional and residential work; on a new church and educational building he had classmate **Bill Cavanaugh** consulting on the acoustics. . . . **William B. Whiston** earned a Ph.D. in Economics from Harvard in June 1972, and is now the Director of the Center for Business and Economics Research at the University of Massachusetts. . . . **Julius Leonhard** is operating his own show, consulting in the field of telecommunications systems. . . . To make the Army's "Cheyenne" helicopter easier for pilots to handle, **Edwin Gabriel** solved a bunch of dynamic equations of motion on an EAI8800 computer, and then designed the self-organizing/fast-learning controllers.

Polaroid has advanced **George H. Fernald, Jr.**, to Assistant Vice President. He's responsible for managing two new color negative manufacturing plants. . . . **Milt Robinson** is currently Assistant Professor at Kent State University, serves on the Ashtabula School Board; sails Lake Erie with wife and three daughters. . . . The Xerox Corporation granted a Social Service leave to **Bill Gable** to work with the Protestant Community Services agency in South Central Los Angeles. His job is to help low-income minority families achieve home ownership. Methinks if more of our brainy '51 compatriots would get involved, a lot of social problems could be solved.

Regret to announce the passing of **Stephan Nagy**, famous microanalyst and Director of the Microchemical Labs at M.I.T.

Our **Charles R. Houska**, a Professor of Metallurgical Engineering at Virginia Tech has been chosen as one of the Outstanding Educators of America for 1972. He earned all degrees—S.B., S.M., Sc.D. at M.I.T. . . . Meanwhile, back in

Gerald D. Laubach, Ph.D.'50, "moves with highly deceptive economy and dry wit over an envigorating range of policy issues," says Chemical and Engineering News. *Dr. Laubach is now President of Pfizer, Inc., after a career which began in research and continued into management as Vice President-Medicinal Products Research (1964), President of Pfizer Pharmaceuticals (1969), and Executive Vice President (1971). (Drawing: C&EN)*

"A Brilliant Operating Man" on Antiscience and Drugs of the 1970s

Chemical and Engineering News caught up with Gerald D. Laubach, Ph.D.'50, the new President of Pfizer, Inc., after an "untimely delay on a shaky commuter plane from Connecticut." But the confusion did not weaken "the analytical grasp and conversational tone which have given (Dr. Laubach) the reputation of a brilliant operating man," says *C&EN*.

Here is a condensation of the subsequent interview, as reported in *C&EN* for January 22:

By any measure, Pfizer is in the top level of capitalistic undertakings. Last year's after-tax profit margin of more than 9 per cent on sales of more than $1 billion was merely an ordinary performance. This profitability reflects a stake in innovation which has maintained Pfizer's research and development spending at a high 4 per cent of sales and capital spending at roughly 9 per cent of sales.

Dr. Laubach has graduated from early research work—he joined Pfizer in 1950—to a series of efficiency-minded tours in management. He has pushed innovation in the company's older businesses, including drugs, chemicals, and animal health products. And he has overhauled research and development to stress interdisciplinary work.

Discussing the crucial political hurdles facing Pfizer in the 1970s, Dr. Laubach notes that his company's number of new drugs has compared well with the industry average in recent years. But "we have to be concerned at the slow progress in the last decade," he thinks. And he is especially concerned by the pervasive rise of cautionary attitudes toward drugs throughout society. At a time when the drug industry is taking on the worst killers of all, such as heart disease and cancer, the suspicion has crept into society that "drugs are probably a bad thing," he says. Indeed, he considers antidrug sentiments merely part of a broad antiscience feeling which has resulted, for example, in a flood of students going into premedical courses instead of into scientific fields that could yield more powerful solutions to problems.

What would a new drug in the 1970s be like? Dr. Laubach leans toward incrementally different substances in areas such as cancer rather than toward revolutionary products, although he does not rule out the latter. Noting the awe given at first to all scourges beaten in the past, he says that, although cancer is a "tough nut," the tools being brought to bear are powerful and theories probably not "too far wrong. . . . Once it's done [solved], we'll say, 'Gee, of course that was the way to do it.' "

Cincinnati, **Howard Schwartzman** has rejoined P. and G. to head up an engineering group working on environmental control problems. . . . *Science News* reports that **Herbert G. Vaughan, Jr.** is a member of a task force on behavior control at the Institute of Society, Ethics and the Life Sciences at the Center in Hastings-on-Hudson, N.Y. Herb is from the Neurosurgery Department at the Albert Einstein College of Medicine in N.Y.C. . . . A distinguished member of our Class, and a recent Visiting Professor to Tech's Department of Earth and Planetary Science was Dr. **Seiya Uyeda**, who received the Alexander Agassiz Medal from the National Academy of Sciences in Washington for "outstanding contributions to the tectonic and thermal history of the earth." . . . And finally, another product of the M.I.T. Department of Earth and Planetary Sciences (Geology Department we used to call it) is **Breene Kerr**, who is also a Term Member of the Corporation by virtue of his being President of the Institute's Alumni Association for 1972-1973. Breene is busy in oil, manufacturing, automotive concerns, and many other endeavors through his Resource Analysis Management Group in Oklahoma City.—**John Dowds**, 1800 N.W. 18th Street, Oklahoma City, Oklahoma 73106; **Fred W. Weitz**, Secretary, 4800 S. W. 74th St., Des Moines, Iowa, 50321; **Marshall Alper**, Assistant Secretary, 1130 Coronet Ave., Pasadena, California 91107; **Samuel Rubinovitz**, Assistant Secretary, 3 Bowser Rd., Lexington, Mass. 02173

54

Our class President, **Bob Warshawer** has appointed **Harvey Steinberg** our 20th Reunion Chairman. Tentative plans from Bob and Harvey indicate a dual reunion. In Boston on Sunday, June 3, there would be a Mini-Reunion in or near the Student Center. In Bermuda, sometime between May 15 and June 15, there would be a full weekend of events. Let's hear from you with your ideas. The alternatives appear to be the one day Mini-Reunion, a weekend in Bermuda, or perhaps the traditiional weekend near Boston. We only have a year to get ready and commitments have to be made early. Your ideas can come to us, to Bob, or to Harvey at 273 Singletary Lane, Framingham Centre, Mass. 01701.

Ezra Ehrenkrantz is completing an eight month appointment back at Tech as Bemis Visiting Professor in the Department of Architecture. . . . **Ed Eigel**, who ably served as our Class Secretary for many years, reports that besides serving as Academic Vice President at St. Louis University, he is Professor of Mathematics, Chairman of the Board of Trustees of Christian Brothers High School, Secretary of the St. Raphael Parish School Board, and a member of the St. Louis Planetarium Commission. . . . **George Filak** is on a "two to six year" overseas assignment in jolly ole London for Texas Instruments. . . . Our popular classmate **Frank Ahearn** is also reported on that little island. Something about management consulting we hear.

Avron Spector is developing new procedures and equipment for air navigation at the Federal Aviation Administration in Washington as part of a federal program to swap business and government expertise. Doesn't sound as exciting as Peterson and Kebich but Avron was nominated by Litton top management for this important one-year assignment. . . . **George Spoll** has recently been elected Vice-President and Life Directorship of the National Association of Home Builders. He enjoys the extensive travel associated with these responsibilities as well as a healthy, luxury-home-building business. George, we are going to call you when we build our next $100,000 home. Imagine going from a student member of the Association of General Contractors of America to President of the National Association!

David O'Brien is also in the homebuilding business, Dave is President (it helps being the owner) of O'Brien Homes Inc., operating in Rochester, N.Y. area. He is building at the rate of 400 homes per year and has a mix of singles, townhouses and four plexes. . . . Another business-owner, **David Wiesen** took a year to move his firm (Adec Inc.) to Fairfield, N.J. Dave says "If you haven't done it, you don't know what tired is." Dave, you are supposed to use trucks, dollies, lifts, etc. We agree pushing equipment up those N.J. hills does wear one down. . . . **John Radbill** continues to work in the Engineering and Scientific computing section at J.P.L. Has been enjoying life with skiing in the winter and backpacking in the summer. Also has been active with Technology Associates of Southern California, a consulting firm formed by M.I.T. alumni in the Los Angeles area. . . . **Stanley Kolodkin** has been appointed Division Vice President and General Manager for R.C.A. Aero-Space Systems Division, of Burlington,

S. S. Kolodkin, '54

Mass. Well Stan, if you recognize two ole classmates waiting in the employment office, please tip your hat on the way by, it may help us. Stan and Judy and their three children live in Lexington, Mass.

Joseph Hurley has been appointed Director of machine technology by Corning Glass Works. Joe joined Corning as a product engineer in 1955, was Manager of the Canton, N.Y., plant in 1966, and has progressed to successively higher management positions.

Alex Dreyfoos invites all classmates to visit him if they get in the area. Nice area, Palm Beach. Alex has a Cessna 310 and owns Photo Electronics Corp. His Company was presented with an academy award for Technical Achievement by the Academy of Motion Picture Arts & Sciences. Alex has started a new division, PEC color Labs to do high quality, professional film processing and printing. Send the Cessna Alex and we will be happy to come on down and take a few pictures of the latest doings at the beach to help you maintain production.—**Dave Howes**, Box 68, Carlisle, Mass. 10741; **Chuck Masison**, 76 Spellman Rd., Westwood, Mass. 02090

55

At last there are the warmer winds of May to push plans of gardens and summer trips into action. Before you get the boat ready, why not drop me a line so that your classmates can read what you did all winter?

Walter G. Shifrin is associated with the consulting engineering firm of Consoer, Towsend and Associates. Two years ago he was made a general partner, and he is in charge of the St. Louis Branch design office, with a staff of about 20. . . . After almost 18 years with the same employer, **William D. Chandler** recently received a new assignment, from being Director of Corporate Planning in San Francisco to Assistant General Manager of the Pulp and Paperboard Division of Potlatch Forests, Inc., in Lewiston, Idaho. . . . **Douglas A. East** has been promoted to Vice President, Maintenance and Repairs Division, of Riley Stoker Corp., in Worcester, Mass. . . . **Frank Buck** is currently in charge of operating the first production cyclotron in the world for New England Nuclear Corp., in Billerica, Mass. The Bucks' sixth child, Amy, was born in October of last year. . . . **David F. Barnes** is now engaged in computer system design for Xerox, managing their new Midwest Technology Center. . . . **David Kramer** writes that he and Sandy spent three weeks in the U.K., France, and West Germany. He was part of a team sent by the A.E.C. to exchange technical information on radiation effects in metals used for fast breeder reactors. . . . **Robert P. Greene** is back at M.I.T. as Associate Director for Administration of the System Dynamics Group in the Sloan School. The Greenes have unpacked in Sherborn after three years in Indonesia. They enjoy the winter weather, and even the traffic, after their stay abroad, but I suspect the Indonesian ambiance will be a fond memory.

A note from **Homer P. Harechester** informs me that this summer he will be attempting the first circumnavigation of Baffin Island by tidal current only on his new papier-maché raft, *Arg*. Homer's first love is the sea, but he has spent the past seventeen years as the guano producers representative in Tannu Tuva, and now with this forthcoming trip he will probably return to the sea. Watch for it on your local newcast.—**Allan C. Schell**, Secretary, 19 Wedgemere Ave., Winchester, Mass. 01890

56

Bob Carlson has spent the year as a Visiting Professor at the North European Management Institute in Oslo, Norway. . . . **Irwin Dorros** has been named Executive Director of the Network Planning Division of Bell Laboratories at Holmdel, N.J. Irwin will have much to do with the successful operation of the A.T. and T. systems of the future. . . . Dr. **Steve Freedman** has been named Vice President and Head of the Technical Center of International Utilities, Energy Systems, Inc., in Braintree, Mass. As a result, Steve, Joan and family have returned to Wayland from Philadelphia. . . . **Dick Miller** is Area Manager at Measure Corp., a company specializing in Industrial Process Control Systems.

Don't forget the Mini Reunion at 5:00 p.m. on Sunday, June 3, at the Student Center. Call **Bill Grinker** at American Used Computer, 15 School St., Boston, 617-227-8634.—Cosecretaries: **Bruce B. Bredehoft**, 3 Knollwood Dr., Dover, Mass. 02030; Mrs. **Lloyd Gilson**, 35 Partridge Rd., Lexington, Mass. 02173

57

I am sorry to have missed last month's notes. I was away at deadline time in Mexico on business. I have a lot of material for this month's report which I hope will compensate for my sin of omission.

Dick Mortensen sent the following cheerful note: "I have decided that Technology is a menace to the human race. I have dropped out and I intend to work toward the abolition of the profession of Engineering." . . . **Joel Schiffman** writes that his three-men group of orthopedic surgeons wil be expanding to four within the next year. He finds that Alexandria, Va., continues to be a stimulating place to live and practice. He is planning to attend the 12th International Annual Meeting of Orthopedic Surgery held in Israel in October.

Jim Cunningham wrote me that he is organizing a "Mini Reunion" in June and asked for some publicity in this column. He indicated that some local (i.e. Boston area) promotion efforts will be started in April. Here are some of the plans for the Mini-Reunion. It will be held on Sunday, June 3 between 5:00 p.m. and 6:00 p.m., in or adjacent to the Student Center. The cost will be $3 per person including drinks and snacks. If our class can round up 30 persons the Alumni Association will provide a private bar. If fewer than that number attend, our class will probably be joining one or more adjacent classes. All those who are interested should contact Jim Cunningham at Imlac Corp., 150 A Street, New England Industrial Center, Needham, Mass. 02194; Telephone (617) 449-4600. I'm sure Jim could use your help on the promotion side (P.S. Considering how much you guys drank at the Class Reunion, $3 is a real steal!)

Mel Cohen dropped us the following lines: "On March 1 of this year, I became Assistant Director of Physical Processes at Western Electric Company's Engineering Research Center. The Center, located in Princeton, N.J., is responsible for anticipating new Bell System product design technology and developing associated process technology. In my new position, I am responsible for Research and Development in Lasers and Optics. I had previously been Supervisor of the Laser Processing Study Group at Bell Laboratories in Murray Hill, having been at Bell Labs since the end of 1964. My family continues to reside in Berkeley Heights, N.J., in the Murray Hill area. My wife, Elaine, teaches school in Berkeley Heights and our three children are ages 10, 7 (boys), and 5 (girl). We are all very much involved in a variety of community activities, including an intense involvement in politics, ranging from campaign manager for local candidates to a county finance chairman in the past presidential election." . . . **Albert Klainer**, has joined the West Virginia University School of Medicine faculty as Professor of Medicine and Head of the newly formed Division of Infectious Diseases. The press release accompanying this appointment reads as follows:

"Dr. Klainer was Associate Professor of Medicine and Medical Microbiology at Ohio State University College of Medicine, where this year he was chosen for Outstanding Teacher Awards by both the University Hospital staff and the senior medical class.

"An exhibit on "Urinary Tract Infection: Practical Aspects of Diagnosis and Treatment" presented by Dr. Klainer and two Ohio State colleagues won the Thomas G. Hull Award for highest scientific excellence at the American Medical Association clinical meeting last fall in New Orleans.

"Part of a major new exhibit on drug action at the cellular level for the Smithsonian Institution in Washington, D.C., is being prepared by Dr. Klainer. At the W.V.U. Medical Center, Dr. Klainer will continue his research. He is author or co-author of 30 publications. "Dr. Klainer was graduated cum laude in 1961 from

Tufts University School of Medicine. His internship, residency and a fellowship were served at New England Medical Center Hospitals, and he was an instructor in medicine at Tufts and an associate physician at Harvard University Health Service before entering the Army in 1966. He began teaching at Ohio State in 1968. He is a Fellow of the American College of Physicians. Dr. Klainer and his wife, Jo Ann, and their three children reside in Morgantown."

George McVehil brings us up to date with the following information. He is married and has three children. Presently he is Director of Technical Services for the Sierra Research Corp., in Boulder, Colo. He is doing consulting work on environmental problems and air pollution and managing the sales of environmental data monitoring systems. . . . **Leonard Kedson** is President of Solid State Scientific Corp., of Montgomeryville, Penn. The company is engaged in the production of integrated circuits for electronic watches and automotive electronics. . . . **Martin Zombeck** dropped us a brief note that he is now working as Physicist for American Science and Engineering in Cambridge. He is a Project Scientist for the solar x-ray telescope on N.A.S.A.'s Skylab to be launched this spring. Martin is married and has two boys.

That's all for this month.—**Fred L. Morefield**, Secretary, c/o Mobil Oil Caribe Inc., P.O. Box X, Caparra Heights Station, Puerto Rico 00922

58

REUNION SPECIAL! Here is a special bulletin from our correspondent Lou Giordano at Reunion headquarters, "We hope you've already decided to join us on our 15th Reunion on Martha's Vineyard, *but, . . . if you haven't,* here are two *"Hot line"* numbers to call to get you on board: **Lou Giordano** at 617-263-9608 or **Gary Fallick** at 617-862-7208. Phone now for details because it's not too late but this is positively your last chance (well, uh, almost your last chance—we'll be glad to see you even at the last minute).

For those of you who will be sunning and funning in just a few short weeks, all that remains is for you and yours to start gearing up mentally for a truly *great way to start the summer.* We can assure you that the Reunion Committee has not overlooked one detail in providing the prospects for a top-notch entertaining, get-away-from-it-all weekend." That's the view from here, now it's up to you. See you all on June 1-3 at the Harbor View in Edgartown.

Talked recently with **Mac Jordan** and learned that he has recently been appointed Manager of the Analysis and Planning Department of Kerr-McGee Chemical Corp. In this position he is responsible for handling economic studies and market research activities. He is also serving as Vice President-Programs for the Oklahoma City chapter of the Society for the Advancement of Management. . . . From Australia **Mike Balderston** writes, "Our first year down under has been spent getting settled and learning to understand strine. In many ways we like it better than the U.S. but with family, friends and cheap beer back there, I might not extend my contract here.

The Australian National Satellite program is progressing slowly but may speed up under the new government. Looks like I'll miss the 15th Reunion but will try for the 20th." (The Reunion Committee accepts only distances over 4000 miles as a valid excuse for non-attendance—everyone else is expected to be there or send a note.)

John Boynton's first book of poetry was so well received in Houston that he has published two more volumes. John says that "classmates interested in what kind of poetry an engineer writes can write me directly to obtain all three volumes. Guaranteed to turn on wives!" (Well, now we know what kind of poetry *that* is but why is it limited to wives, John?) . . . **Bill Hauke** is "engaged in the construction business building about 30-40 houses a year plus some shopping center work, remodeling, etc. Carol and I are active in work with Scouts and retarded children, also find time to square dance for recreation. We now have four children." . . . A brief note from **David Nixon** who is alive and well and working at General Radio and living in Acton, Mass., "My wife and four-year-old son spend our summer, free time in Maine where I have been investing in land and rejuvenating old cottages."—**Michael E. Brose**, Secretary, 30 Dartmouth St., Boston, Mass. 02116

59

Would you believe we are nearing the last issue of the year, and, if you've been following this column you will note that the Class of '59 has been in every issue! *Mirabile Dictu!*

John Brackett, whose work we noted in a recent issue, has been promoted to the position of Vice President of Software Production at SofTech, Inc., in Waltham, Mass. . . . **Gary Bracken** writes "We returned to U.S.A. last year after spending two years in North Africa where I was Resident Manager for a major international construction company in Libya. You don't really appreciate the U.S.A. until you leave it for awhile. My wife Nancy and I have three boys and are enjoying Colorado very much. I am Chief Engineer for a new pipeline contracting company headquartered in Denver." . . . Also from the back of the envelope, **Dave Woronoff** informs us . . . "I am now engaged in the private practice of law specializing in patent, trademark and copyright work with offices in Stamford, Conn., and Somerville, N.J."

Gene Zuck writes "I am presently Technical Marketing Manager for Dynarad, Inc., in Norwood, Mass. Dynarad designs and manufactures a line of infrared thermal imaging systems which are used in science, medicine, industry and military to study thermal phenomena. Switched to this company at mid-year after spending several months in consulting work with two other colleagues. . . . **George Yerid** is in practice as an Orthopedic Surgeon in Lowell, Mass. . . . **Bob Polutchko** sends "Greetings from Mile High Country.

J. W. Brackett, '59

Pleased to announce that I was awarded 'Engineer of the Year' for Denver division of Martin Marietta at division ceremonies in Denver and 'Engineer of the Year' of Martin Marietta Corporation at corporate ceremonies in Wash., D.C. for development of multiple nozzle terminal descent rocket engines for Mars Lander-Project Viking." Bob, may I add the congratulations of your classmates to the many you've doubtless already received. Good show!

Two personal notes to close off this column: **Bob McAuliffe** has picked up the gauntlet, as follows," Your Notes in the January *Review* certainly imply that the work of a harried editorial writer (editor, —Is that what I am? (Is taxing. I'm always willing to rush into the breach for fellow '59ers. Course I may be a long way (numerically, at least) from Course XXI, but you can consider this my application for the job." Consider it considered! . . . **Anne** and **Bill Cooks** wrote me a nice letter, saying "Bill and I were both stunned and saddened to read of the death of Bob Keene in October; I am only sorry that it has taken such an unfortunate event to stimulate this letter, our first, to the Class Notes. Bill and Bob were both D.U.'s together, and in addition to the normal fraternity brother ties, were close friends. I remember with fondness some very wild motorcycle rides with all three of us on the B.S.A.—Bill driving, Bob on the back and me on the gas tank, up front. We are currently living in Santa Monica and have been since late 1957. Bill is working at Programmatics, and I have a part-time job at the local school board. We spend our weekends travelling around California, hiking, snowshoeing, and (naturally) motorcycling. Our three children, Steven, Paul, and Andrea, are 12, 11, and 10. I realize that this information barely scratches the surface, but anyone wanting to get to the nitty gritty can write us at 503 22nd St. Thanks for the column. We enjoy it." Well, see you all next year. Until then, keep those cards and letters coming.—**A. J. Collias**, Secretary, 61 Highland Rd., Brookline, Mass. 02146

62

David J. Bromer has announced his candidacy for the office of Housing Authority in Watertown, Mass. He has been an active observer of the Watertown Housing Authority and believes that more can be done to help those people in town who most deserve housing. He is employed

as a research scientist by the Gillette Co., South Boston.

George C. Pedersen, his wife Pauline and their four children moved to Buffalo in 1970. He is a licensed engineer in New York and currently Research and Development Manager for the Globe Albany Corp., a Division of Albany International. . . . **Peter G. Anderson** informs us that he is now Associated Professor, Computer Science, at Newark College of Engineering. . . . **Keith M. Ferguson** has bought a townhouse in San Jose, Calif. He is with Hewlett-Packard Co., and made a tour of Europe last summer for the Marketing Dept., but now is back in the lab "inventing."

Captain **Glenn A. Buckles**, his wife Pam and their twin sons, Aric and Aron, are now settled in Bellevue, Neb., after their move from Washington, D.C. His new assignment to the Joint Strategic Targets Planning Staff is as challenging as his last one in the Pentagon.—**Gerald L. Katell**, Secretary, 122 North Maple Dr., Beverly Hills, Calif. 90210

63

Class Reunion, Harborview Hotel, Edgartown (Martha's Vineyard), Mass. June 8-10, 1973.

The choice of Edgartown for Tenth Reunion is being applauded by all who attended the Fifth Reunion. We have changed hotels to the Harborview at the end of Water St. which runs for a few blocks from the center of town to the Edgartown Lighthouse which marks the harbor entrance. The Harborview is directly across from the lighthouse. Water St. is lined with beautifully preserved 100 year old homes, built by the whaling captains, which are now summer places for captains of American industry. It's this spirit of another age that makes Edgartown such a favorite and adds to the feeling of being away.

As you can tell, I get enthusiastic about the Vineyard. After going there I am sure you will too. See you at the bar on the ferry. If you are not now registered contact our Reunion Chairman, **Tom Gerrity** as soon as possible in one of the following ways: (617) 492-1500 or: c/o Index Systems, One Broadway, Cambridge, Mass. 02142. At this point a phone call is probably preferable.

If anyone is planning to come by private sail or motor boat, I have sailed to the Vineyard a couple of times and will be glad to discuss it. I will be glad to answer other questions as well, since I have been to Edgartown several times. Reach me at: (516) 364-0560 (Workdays) or (617) 631-7718 (Weekends).—**Martin H. Schrage,** Secretary, 55 Brackett Place, Marblehead, Mass. 01945

64

This merry month of May has brought forth two Class Heroes who have written in detail of their activities. The first of these is **Geoff Nelson**, whose family of a wife, two children, a dog, and four cats are currently living in Mountain View, Calif. After receiving his M.B.A. at Stanford in 1966, Geoff worked for several years in Boston, and now is President of his own firm, Iotron International, Inc. His last job took him back and forth from Europe on numerous occasions, but he is now settling down to the world of northern California. He extends a free meal voucher (or unlimited Cutty Sark) to any classmate who strays in the area. . . . The next Class Hero is **Henry Noble**, who is now a lawyer in the Trust Department of the First National Bank of Maryland. On his way to getting his J.D. from American University in 1972, Henry worked at the Instrumentation Lab and for Computer Sciences Corp., in Virginia. His prior career took him around the world twice, first in 1968 when he went to Saigon to analyze "McNamara's Wall," and again in 1969 when he spent three months in Thailand.

As for news of others, **Mike Auerbach** reports that he is living in Longmeadow, Mass., where he is Treasurer of the Springfield Jaycees. . . . **Edward Graham** received his Ph.D. from Carnegie Tech in 1969, married the former Barbara Bramble who is now a third-year law student, and working for Montgomery County, Maryland on computer applications for water resources and pollution control. . . . **John Graham** is a staff psychiatrist at West Point Military Academy, with his free time fully occupied with his own 18-month-old son. . . . **Joe Kirk** is Vice President of a management consulting firm in McLean, Va. Joe is also starting goalie of the semi-pro Washington Chiefs hockey team, which with his wife and two sons keeps him busy. . . . **Richard Kline** and his wife Janette had their second son born in January of this year. . . . **Otis Philbrick** is Vice President of Information Designs, Inc., a computer applications firm in Bedford, Mass. Otis enjoys mountain climbing and color photography. . . . **Edward Shibata** is an assistant professor in the Physics Department at Purdue. . . . **Alfred Spencer** is a member of the Research and Development group of Computer Library Services, Inc., in Wellesley, Mass. . . . **R. E. Warakomsky** is Chief of the Electronics Engineering branch of the Coast Guard in Juneau. . . . **Robert Wild** received his J.D. from Cornell in 1970, and is now in the middle of a clerkship for Supreme Court Justice Rehnquist. Robert, his wife, and child and a half plan to move to Rochester, N.Y. in July. That's the news for now. Let me hear from you.—**Ron Gilman**, Secretary, 5209 Peg Lane, Memphis, Tenn.

65

Richard Freedman sent a letter with the comment that some information is lost in transit from the Alumni Fund. He sends an update on his activities since graduation. After working for M.I.T. for three years, Richard went to the University of Western Ontario and obtained an M.Sc. in computer science. Then he spent two years in New York City, acquiring a wife (Connie) and two children (Chris, 12 and Keith, 8). Deciding that New York is no place to raise kids, the Freedman's moved back to Canada where Richard works for the computing centre (sic) at Western Ontario. Richard is still an active bridge player, and has won the New England Master's Pairs and the Goldman Pairs, thereby passing 1000 master points. . . . **Dave Driscoll** changes assignments at M.I.T. in December from treasurer of the M.I.T. Development Corporation to Assistant Treasurer of the Draper Laboratory. . . . **Lou Goldish** is Vice President of Technical Marketing Associates of Concord, Mass. . . . **John Edgar** is a captain in the Air Force and is now at Eglin A.F.B., Fla., working on advanced gun and ammunition technology. John recently completed a four-year tour at the Space and Missile Systems Organization working on navigation satellite systems. . . . **Fred Stegeman** is an architect and general contractor responsible for design and construction at Morrissey, Scott, Miller, and Stegeman, a development and consulting firm in Los Angeles. . . . Finally, in the career department, if anyone wants to change jobs, **Bill Park** reports that Moore School of Electrical Engineering at the University of Pennsylvania has openings for three new assistant professors in computer science next fall.

Dick Tsien sent a note with a lot of news about other folks. He reports that Jan and **Jim Wolf** had a son as did Criss and **Jay Rogers** (their second). (We reported Josh Wolf in February). Dick accuses the old bachelor (me) of falling behind and says that he and Julie are leading a quasi-student existence with lots of student flicks, etc. in New Haven. . . . **Ray Fisher** married the former Sally Corcoran of San Gabriel, Calif., on February 1, 1969. He finished a Ph.D. in plasma physics at CalTech in 1970, then spent a year and a half of post-doctoral research at Yale before returning to California. Ray is now at Gulf General Atomic in La Jolla working on controlled nuclear fusion. . . . And **Hank Lichstein** reports that he, Janine, and son Daniel have moved to a Riverside Drive (New York) cooperative where Daniel, 18 months, runs the house.

That's May's slim column. Write a letter in honor of spring.—**Steve Lipner**, Secretary, 3703 Stearns Hill Rd., Waltham, Mass. 02154

66

In these Class Notes I have finally caught up with all the bits and pieces of news received over the past several months. Summer is always a quiet time for class news, so all cards and letters will get prompt attention. Several classmates are newly married. . . . **Barnet Wolff** married Erica Siedner. He reports that he is "happy, still computing, playing poker." . . . **Don Schwanz** was married last April and spent his honeymoon in Hawaii. . . . **Saul Mooallem** married Susan Handlin of Springfield, N.J., in October. He is working in computer software development at Control Data in the Toronto area. . . . **Stu Shapiro** writes, "On July 16, 1972 I married Caren D. Knight at her brother's home in Walnut Creek, Calif. . . . **Dick Gray** was best man. Dick's wife Lillian was there, as were **Dan Allen** and his wife June. We now live in Indiana where

I am an Assistant Professor in the Computer Science Department at the University." . . . A letter from **Dick Gray** further reports, "we are proud to announce that we both have our same jobs, that we have not increased the size of our family and that we still live in Marblehead."

As a result of other earlier marriages I have a number of births to announce. **Betty Jean McKenna** writes that a daughter, Jennifer Lynn was born in November. . . . From **Frederick Webb**, "A son, Michael Frederick Webb, our first, was born in October to my wife Cindy and me." . . . **Jurgen Hahn** writes "Our latest blessing is our son, Warren Michael, born in April. Jurgen is still with International Timesharing Corp., as a product manager. Minneapolis ia a place one can truly appreciate." . . . **Bob Akeson** and his wife now have two boys age two years and eight months. . . . **T. F. van Jienhoven** and his wife Vera are expecting their first child this spring. They are enjoying his first assignment with Bechtel Corp., in Southern Spain where he is the Resident Manager of a large, golf-connected development.

Carlixto Romero is doing cardiology research at the University of Chicago. They have two children, Laura, 3 and Veronica, 1. . . .**John Golden** is living in Wellesley with his wife Carolyn and children Lisa, 6½, Jennifer, 4½ and John, 2½. John is a private pilot and is presently employed by Polaroid.

There are a number of members of our Class still involved in various stages of completion of various degree programs. **Don Morrison** writes "I got my Ph.D. in 1970 from M.I.T. in Materials Science. I worked for a year at Brunswick Corp. When Brunswick moved to Chicago, I moved to Polaroid where I am extremely happy working on one of Polaroid's two major new products: instant color transparencies. Trudy finishes her Ph.D. in January." . . . **Yoshiharu Moriwaki** was married last July and is still working on his Ph.D. in Soil Mechanics at Berkeley. . . . **Jim Miller** finished his Ph.D. in math at Maryland and now has a one-year Internship at the National Center for Atmospheric Research in Boulder. . . . **John Torode** finished his Ph.D. in Computer Science at the University of Washington and is now an Assistant Professor of Computer Science at Berkeley. . . . **Roger Rasmussen** says that he is "still grubbing away on my Ph.D. and plan to finish this year." . . . **Hans Bozler** received his Ph.D. last October from the State University of New York at Stony Brook. . . . **Stephen Shao-Chung Chang** completed his Ph.D. in Physics at Columbia and is now working there as a Post Doctoral Fellow. . . . **Terry May** received his M.B.A. from U.C.L.A. with honors. He is now Controller of Mayco Manufacturing in Los Angeles. . . . **Mark Yogman** finished his L.L.B. and is working for Mobay Chemical as a Planning, Coordination, Operations Research and Informations Systems Analyst.

I received a particularly good letter from **Bill** and **Eleanore Klepser**. "Bill has taken a job in the Process Research Center of Corning Glass. We added a new member to our family this year, Erica Lynn, our second girl. We had a visit from **Betty VanderMolan** McKenna and her husband Bill earlier this year. They just had their first child, Jennifer and both work for I.B.M. in New Jersey. . . . **Margaret Shork Chatterton** and her husband **Howard** also visited us this past summer. They have two girls, Jacqueline and Christy. Margaret works for the A.E.C. and Howard for the Coast Guard." . . . **Rusty Epps** is working in Palo Alto for Watkins-Johnson. . . . **Berton Barrington** writes "I have two years left in ophthalmology residency at Mayo Clinic, four in our family now and forever." . . . **Arlee Reno** continues at the Urban Systems Laboratory at M.I.T. working with a project on transportation and environmental values. . . . Former Class Secretary **Terry Vander Werff** writes "after two and a half years in Colorado we are leaving, first to Houston's Methodist Hospital on a research grant, after that, who knows? We hope to return to Oxford for a month this summer to visit all our friends there." . . . **Rich Lucy** and **Ralph Schmitt** both wrote to describe their new venture. From Ralph, "I joined Rich in March 1972 to build a better bathtub—one made of acrylic plastic. Our company name is 'The Plastics Group,' our president is a mad englishman, and our sales will have gone to about $3 million per year this December." Both Rich and Ralph left the security of the aerospace industry for a taste of the *Real World*. . . . **Dave Penny** is working with other Christians in Tunisia to develop a self perpetuating agricultural economic program for the Tunisian people. . . . **Jack Mazola** transferred from sunny California to Pennsylvania. He's now a section manager with Burroughs Corp. He and Ann have two children, Shari and Michael. . . . **Dave Ljungquist** is now working as a "program manager" for Innotech in Norwalk, Conn. He runs programs in planned invention in both technical and consumer product areas for client companies. . . . **Jim Lash** reports "management consulting continues to be a rewarding challenge—building a house is harder; we started in October '71 and won't be in until this spring." . . . **Dave Liroff** writes that he has "finally bought our own farm—158 acres of beautiful rolling southeastern, Ohio-hill country. We would like very much to hear from classmates. I continue as a Program Director of W.O.U.B.-TV in Athens." . . . **Joseph Bravman** is now working as a senior development engineer for Ithaco in Ithaca, N.Y., and is engaged in work on attitude-control equipment for satellites. . . . **Robert Poole** continues his research work in criminal justice systems at a Santa Barbara think-tank, Public Safety Systems. In addition, he has become Managing Editor of *Reason* Magazine, a 5000-subscriber monthly libertarian magazine. . . . **Michael Ward** is now manufacturing electronically despun antenna systems for Philco for their N.A.S.A./N.O.A.A. synchronous meteorological satellite. . . . **Rick Williams** is a first-year resident in ob.-gyn. at a hospital in Honolulu. He is soaring, surfing, diving and driving his Porsche. (He must have fun trying to get life insurance!)

Bill Thomas is Assistant Professor of Economics at the University of Houston. He received his Ph.D. in 1970 from the University of Pennsylvania and now has two sons. **Dick Clark** and his wife are living in Rochester where he is completing his first year residency in internal medicine. This summer he will begin a three-year clinical associateship at the Institute of Allergy and Infectious Disease in Bethesda, Md. . . . Captain **James E. Kester** was recently awarded the Air Force Meritorious Service Medal for work done in Alaska during his last assignment. He is working on his M.S. at M.I.T.

I am sorry to report the death of **Ronald Perlman** in December of 1971. I have no other information and would appreciate any additional details his classmates may have.

Best wishes for a good summer. Hope you'll all have time to make the Mini-Reunion in June. Remember me when you're on vacation. Send all cards to—**Tom Jones**, 59 Commercial Wharf, Apartment 6, Boston, Mass. 02110

67

Jeff Schoenwald dropped by for a visit during his latest trip to California. Although Jeff claims to be in graduate School at the University of Pennsylvania, he has taken three trips to Europe and four trips to California. However, it is not all play; he came West to search for employment and to speak at a conference as a world's authority on one of the most obscure branches of solid state physics. Jeff also notes that **"Bob Schwartz**, a Ph.D. candidate at University of Pennsylvania, used to be as solid as the Rock of Gibraltar, but that married life has made him as round and soft as a scoop of ice cream in August."

Tim Gill sent an interesting letter: "I dropped out of graduate school and got involved with the campaign of Gene McCarthy. I decided that the most important thing, for me, was to contribute absolutely nothing to the war machine, i.e. the national economy. To support myself I invented a trivial novelty, 'Kozmicdust,' and became self-employed. Last summer I perceived peace in the air, and I started to feel better. My sales were declining so I researched a few things. I remembered years ago fixing scratches on records with a razor blade and a steady hand. I designed and built a device to do it, but it didn't work when I tried multiple blades. Kozmicdust inspired my father to dabble in business more than ever before. Now his business is doing well. I am home now to design packaging and marketing for Nine Man's Morris, an English game referred to in *A Midsummer Night's Dream*. For a year I have been travelling all the time and staying with friends all over the East Coast. I will settle down for a few years to make money on Solar Energy, but every degree of success finances a new mode of travel."

Al Hayes gave up skiing for a year and managed to complete his Ph.D. He is now a designer of special purpose computers with a small firm in Salt Lake. . . . **Angela Sotelo-Lopez** is head of the Lab Bromatologia in the Dept. de Investigación Cientifica of the Instituto Mexicano del Seguro Social, and a Professor in the Chemistry School Universidad Nacional

Autonoma de Mexico. . . . Last October, **Philip Manly** was made the Department Head of Radcon, Code 105T, at Pearl Harbor Naval Shipyard. The department, which includes seven engineers, is responsible for radiation controls, primarily during refueling operations on nuclear submarines. . . . **John Smith** is working hard as an intern at Los Angeles County General Hospital. Although he has seen much of the United States, he thinks that Southern California is number one. John now has his private pilot license. . . . **Richard Haberman** spent an enjoyable year in San Diego and is now Assistant Professor in Department of Mathematics at Rutgers.

On July 19, 1972, a bubbly baby girl, Jennifer, was born to Susan and **Mark Grossman.** Mark is still trudging toward his doctorate in statistics while employed as an operations research analyst at R.C.A. in Princeton. . . . **Henry Link** writes: "After working the aerospace industry for three years I was finally laid off. I soon found a very interesting job as a physics and chemistry teaching assistant in a local high school. On a camping tour of the United States I visited Jean and **Frank March** in Reston, Va., and helped 'marry off' **Chuck Spann** who is in Charleston, W.V. I also enjoyed meeting old friends at the Class Reunion. I am now working as an environmental engineer in Wethersfield." . . . **Jon Sussman** has joined Telectro Systems as Vice President in Charge of Engineering and is living in Melville, N.Y.

Paul Caragine has completed a straight surgical internship and is now an orthopedic surgery resident at Martland Hospital in the ghetto of central Newark. . . . **Bob Sitrin** received a Ph.D. in Chemistry from Harvard and has been at the Woodword Research Institute in Basel, Switzerland, since January, 1972. Daughter Esther Ann was born in Basel, Mary 11. . . . **Stephen Flaum** has been promoted to Manager of Engineering Department at S. and S. Corrugated Paper Machinery Co., in New York. He is responsible for about 70 employees. Before joining S. and S. Stephen worked as a systems analyst at Grumman. . . . **Lawrence Banks** is still with Hewlett-Packard in Waltham. He and Liz have no kids, but they do have a sheepdog named Sassamon Lord Burlington. . . . **George Jones** has moved to the Denver area as an investment analyst with Hamilton Management Company.—**Jim Swanson**, Secretary, 508 Thompson Ave., Mountain View, Calif. 9040

68

Spring is coming to Washington now and the tourists will not be far behind. Easter triggers a human wave that almost forces the local residents to stay away from the downtown museums, so we spent today on one last look 'til things slow down in the fall. Between painting the house and the sailboat we should be quite busy now. I went to a recent M.I.T. Club of Washington meeting and met the following classmates: **Jerry Grochow**, **Pete Peckarsky**, and **Bill Carlson.**

From the Northwest Territories

We recently received a postcard of downtown Yellowknife, Northwest Territories, from **Charlotte Babicki.** She immigrated to Canada last September and after five months found a job as Manuals Writer for the computer part of the Government of the Northwest Territories. She reports, "It's a little chilly (—35 this a.m.) but beautiful and invigorating."

Milestones

On April 15, 1972, **Mike Krashinsky** was married to the former Katharine Urion. They met during Mike's junior year. They are living in New Haven where Mike is trying to finish his thesis in Economics and is looking forward to a teaching job next year. Kathie got a master's in Education from Tufts after spending a year in V.I.S.T.A. and is now in her second year of teaching first grade in Clinton. . . . Nancy and **Jack Cleary** proudly announce the birth of their first child, Nina, on May 18, 1972. Jack comments, "parenthood certainly forces a change in lifestyle, but we're enjoying it." He is now at the halfway point at Harvard Law and is looking forward to ending his academic career. . . . **Lou Jacobson** married the former Leslie Brauman on June 4, 1972. (Her brother Rusty was in the class of '66.) Having spent four years in grad school in Economics at Northwestern, Lou now works for the Center for Naval Analysis in Arlington, Va., on a contract with the Department of Labor.

Academic News

The hirsute individual picture on this page is none other than our own **Jim Pugh** who received a doctorate from a well known institute of technology last June. His thesis was entitled "Structure and Properties of Trabecular Bone". He is now Director of the newly established Biomechanics Laboratory at the Hospital for Joint Diseases and Medical Center in New York. Besides research, he is also involved in teaching in the Department of Orthopaedics. Barbara is finishing her B.A. in political science at N.Y.U. They are living in New Jersey, about 20 minutes from the hospital. . . . After leaving Cambridge, **Steve Winters** studied philosophy, focusing on the German philosopher G. W. F. Hegel, for three years at the University of California San Diego in La Jolla. Having received a master's there, he is now studying the history of mechanics at Johns Hopkins. . . . **Henry Brenner** received a Ph.D. in Chemistry from the University of Chicago. He is now doing postdoctoral work at Berkeley. . . . **Bob Roach** got out of the navy in December and expects to complete a master's in computer science for George Washington University this Spring. . . . **Don Batchelor** is now a research assistant in theoretical plasma physics. He received a master's degree in December and is now working on his Ph.D. thesis. He amuses himself with some mathematical and engineering consulting. . . . Having completed two thirds of his medical internship, **Chris Davis** went off this winter for a two-week skiing vacation in Austria with his wife Kathleen. In July he will start 12 weeks of flight surgeon training with the Air Force in San Antonio prior to three years active duty. . . . **Steve**

J. Pugh, '68

Wilson reports that he received a Ph.D. from the 'tute in June after the "regulation eight years" and is now teaching math at Princeton.—**Gail** and **Mike Marcus**, Class Secretaries, 2207 Reddfield Dr., Falls Church, Va. 22043

69

No news this month—only to tell you that we will see you at the Mini-Reunion June 3 from 5-6 p.m. in the Student Center—**Richard J. Moen**, Secretary-Treasurer, 179 N. McKnight Rd., Apt. 318, Saint Paul, Minn. 55119

70

It's apparently spring in Boston now, although the winter was so mild, it's hard to tell. Spring brings us a full mailbag, so here goes: **Steve Oreck** (LTJG U.S.N.R.) writes that he and his wife Karen (BU '70) became the proud parents of a son, Gregory Lawrence, on December 7. Steve will be getting out of the navy in June, and plans to return to M.I.T. to spend a year picking up pre-med courses, and then go on to medical school, hopefully in Boston. He recently spent six weeks in the Mediterranean, and is now on deployment for five months in Bermuda, where winter is similar to winter in Seattle: rainy and in the 50's. . . . Last August, **Chuck Lieberman** and Anne E. Rosenberg (Bryn Mawr '70) were married in Cincinnati, Anne's home town. Anne and Chuck met at the University of Pennsylvania during their first week there, over two years ago. Last summer, Chuck worked at the Federal Reserve Board in Washington; his research was published in a Brookings Institution journal several months ago. For the past year and a half, he's been an instructor of economics at the University of Pennsylvania, where he is now working on his dissertation, and can't wait to get out of school. Chuck also sends news of some classmates: **Alain Hanover** and his wife Carol had a baby girl, Judy, a few weeks before Chuck's wedding. The Hanovers live in Watertown. Alain and **Larry Gessman** were ushers at Chuck's wedding; Larry was married several weeks earlier. Quite a busy summer! . . . **Chuck Movit** is engaged to Arlene Berger (Simmons '71); an August wedding is planned. . . . **Wesley Moore** writes that after graduating in '70, he spent the summer working as a janitor. In the fall, he started graduate work in Aero and Astro at M.I.T. in "Flight Transportation."

He had a "bad term" before discovering that being turned off by Operations Research did not preclude his enthusiasm for aircraft design. Wes spent a year as a part-time student before returning to full-time tooling last fall, and finishing his master's in January. In December he was shocked to discover that Boeing "wanted to actually pay me to do what I've always wanted to do—design airplanes." Now in the Seattle area, getting rained on, Wes is waiting for his stuff to arrive from Cambridge. Unfortunately, he had to leave behind his fiancee, Elisabeth Metzner, '74. . . . **Bob Dennis** is still employed as an analyst in New York City's Human Resources Administration. After a year and a half, he is willing to "concede that New York is a pretty interesting place to live, after all; I've become an especially avid fan of the theatre. And I appreciate the fringe benefits of my job, which allowed me to take a three-week vacation in Europe last summer which was a truly priceless and unforgettable experience." Bob also informs us that **Jay Zager** and wife Karen had a baby daughter on November 8.

Short Takes: **Barney Black** is a scuba diving instructor at the Boston School of Diving in Somerville. He's living in Waltham with **Jeff Beck**, who is working for the Honeywell Radiation Center. . . . **Sue Winard-Emerick** has been appointed student representative for the Howard University College of Medicine Anti-Smoking Clinic. Sue expects to receive her M.D. in 1974. . . . **George Biehl** is working on a Master of Education degree. He occasionally sees Marie and **Jamie Jamison**, who live in his town (presumably Jacksonville, Vt., according to the postmark). . . . **Thomas Devine** is hoping to finish his Ph.D. in Metallurgical Engineering in 1973 or early 1974. . . . **Marc Weinberg** sent a short note saying that he is vigorously pursuing his Ph.D. in Mechanical Engineering at M.I.T. Marc married Judith Omansky (Simmons) in June 1971. Judy is working in the Somerville school system, tutoring students with special disabilities. . . .**Tom Hennessey** is Chief Engineer aboard the USS *Dupont* sailing around the Mediterranean. Both Tom and Marc pursued undergraduate degrees in mechanical engineering between lacrosse seasons.

Wayne Wenger has left Procter and Gamble to join his brother at the University of Chicago Business School in pursuing an M.B.A. . . . **Carl Yankowski** has been promoted to Brand Manager responsible for coordination, advertising, and marketing for "Pringle's New Fangled Potato Chips." . . . **Sandy Harlow**, Carl and Robert have been appointed Educational Counselors for M.I.T. Carl has already given a seminar at a Cincinnati high school on "Careers in Science and Technology." It was evidently a very educational experience for everyone involved. . . . Laura has accepted an invitation to serve a three-year term on the Alumni Advisory Council.

Class Gift Revisited: We thought you might like to know how your hard-earned dollars contributed to our Class Gift fund are being spent. We haven't been exactly swamped by proposals (would you believe we've received 7?) but the Class Gift Review Board has so far provided partial or full funding for four projects proposed by M.I.T. undergraduates. Remember that your comments and suggestions are always welcome. In November, we partially funded three projects: (1) A follow-up study of the delegates to the 1972 Democratic National Convention, undertaken by Daniel Gantt, a sophomore in Math.; Richard Parker '74 (Biology); Norman D. Sandler, '75 (Political Science); David M. Tenenbaum, '74 (Electrical Engineering); Michael Thomas, '74 (Urban Studies and Planning); and Neal Vitale, '75 (Humanities). Two of these students, Sandler and Tenenbaum, had previously participated in a study of the delegate composition of the Convention. The current study will attempt to ascertain the involvement of the delegates in the presidential campaign, and to assess their attitudes toward the political process of which they were a part. (2) A proposal by Michael A. Bookman, '76, entitled "Detection and Control of Pollution of the Monatiquot River in Braintree, Mass." Michael hopes to design an efficient electronic pollution monitoring system to provide instantaneous information about changes in water quality, improve the current methods of solid waste disposal in Braintree, and eventually integrate portions of his project into the Braintree high school curriculum. (3) An experimental film on the topic "Man's Consciousness," by Rafal Zielinski, a freshman in the Department of Architecture. The 16 mm color film, with sound, will be 30 minutes in length and will consist of eight main sections representing eight different states of consciousness, starting from man in relationship to himself and ending in metaphysics and the soul. Finally, in February we provided full funding for a study by Bruce A. Lacy, a sophomore in Physics, to test the feasibility of using neutron activation analysis for measuring the composition of atmospheric particulate matter.

That's it for this month. Happy Spring!—**Laura Malin**, 406 Beacon St. Apt. 1, Boston, Mass. 02115; **Robert Vegeler**, 800 N. Smith Rd. Apt. 7-W, Bloomington, Ind. 47401

71

Class of '71 Notes time again. School work saw the last *Tech Review* deadline come and go, but we're back. By now you've probably heard something about the 1973 "Mini-Reunions." They are to be held June 3, 5 to 6 p.m. in or adjacent to the Student Center. Cost will be $3 per person, including drinks and snacks. In addition, there will be an international Buffet for alumni, and an evening at the Boston Pops.

On with news of classmates: **Kevin O'Brien** wrote that "**Bern Krafsig** joined the air force to escape the army. Murphy's Law worked, he didn't get his preferred assignment. He'll get married to Sandy Peavoy this summer. How about a progress report on Kent State Memorial Lecture?" In answer to Kevin's request for a progress report: We need people who are interested in working on it. So far we have just two. If anybody is interested please write and let us know. Just writing to say you're interested in finding out what there is to do does not commit you and no salesman will call. In addition, it would be a big help if people would send in their class gift donations, specifying that the gift is to go to the Kent State Memorial Lectures.

Mike Ondra has settled in Colorado. According to Mike, Fiji West now Includes Mike Sherrard, Paul Malek, Scott Keller, Mic Curd, and Bruce Anderson. He thinks Colorado is beautiful, has great weather, and offers lots of opportunity. . . . **Sally Harvey** is presently working at E.P.A. as a Sanitary Engineer. She's taking night graduate courses at Northeastern. Her present hobby is motorcycling and she appeared on a television special this fall on trail biking. . . . **Peter G. H. Hwang** wrote: "I got as far as the U.S. National Championships in Saber Fencing this summer. Vince Darago and I were on the Coordinating Committee for the Urban Vehicle Design Competition 1972. Free is alive and well in Cincinnati." . . . **Vincent J. Fazis** is a Galaxie, Ltd., planning analyst with product planning at Ford Motor. . . . **Mark Horowitz** is working towards a Ph.D. in the Committee on Informations Sciences at the University of Chicago. . . . **Florence Huang** was married on December 29, 1972 to Mr. Michael T. Sheehan. . . . **Donald H. Layton** is attending Harvard Business School. . . . **Jerome Sheridan** and **Ellen Koerber Sheridan** are both second year students at Southwestern Medical School, Dallas, Texas. They are hoping to return to Boston for their internships when the time comes.

Nazim Kareemi has completed his M.S. in Electrical Engineering from Stanford University and is continuing further graduate work there. . . . **Jeffrey J. Folinus** wrote: "After a year at Georgia Tech teaching and getting a B. Architecture degree, am now back at M.I.T. in the Civil Engineering Department's program in project management as an R.A. working on the I.C.E.S. system." . . . **Glenn Holm** reported: "I am, through circumstance, a U.S. Army SP.4 employed at Walter Reed General Hospital as a lab technician, receiving tissue for the department of Anatomic Pathology." . . . **Robert Terwilliger** modestly wrote that he "is now self-employed as 'Scorpio,' the greatest one-man rock and roll band in the world. 'Scorpio' is now developing his Mod II version of a programmable computer-controlled robot drummer, and also plays guitar, organ, synthesizer, and pedal bass." . . . **Ralph Brindis** wrote: "I received my master's in Public Health in Nutrition from U.C.L.A. last June and am presently doing Endocrinology research at Veteran's Hospital in L.A. I was married December 17 to the former Claire Diana Andersen, with Barry Bochner, '70 traveling from Ann Arbor to be best man. Claire and I are now looking forward to our move to Atlanta next September and my entrance into Emory Medical School." . . . **Lawrence D. Rosenblum** received an M.S. in Organic Chemistry from Stanford in January, and is now employed at Zoecon Corp. in Palo Alto.

Walter Daub wrote, "The mystique of western life has gotten to me. I've gotten

out of engineering and have bought a 1/3 interest in a small okra plantation. As a hobby, I've been competing in amateur rodeos and am now rated in the top ten amateur calf ropers in Tarrant County, Texas." . . . **Richard E. Stat** dropped us a note to say "I have taken a job with General Telephone and Electronics Corp., in New York City after completing my M.B.A. at Wharton. I'm planning to move to the Stamford, Conn., area when the company relocates this spring." . . . **Jerry Kardas** is nearing the end of the work on his master's degree from George Washington University while at N.A.S.A.—Langley. He was married to Jan Kleeman (Wellesley '71) May 27, 1972. Jerry plans to return to the New England area in June, if at all possible. . . . **Marc Paul Kahgan** is currently attending Tulane University School of Medicine. . . . **Frank Taylor** wrote: "I am employed at Frick Chemical lab of Princeton University in the Biochemistry Department under Dr. Charles Gilvarg. For the most part, my work is to grow Bacillus Magaterium (soil bacteria) in a 100 liter fermentation set-up. In my spare time I play tennis." . . . **Jackie Whitney** sent us a card saying: "For the past year and a half I've been hiding out in Pittsburgh, in the physics department at Carnegie-Mellon University. The only thing that's happened worth mentioning in *Tech Review* is that I am officially a Ph.D. candidate. I will get my master's in May and start thesis research this summer."

Nancy Greene wrote, "I just got engaged to Philip Burstein, University of Chicago, '71, who (like me) is in the Ph.D. program in Economics at Yale. We intend to get married early next December, go to Europe for a month, come back and write our dissertations, and then live happily ever after." . . . **Alan Weiss** is in his second year of medical School in Peoria, Ill., and writes "Don't get your hopes up, friends, but I might grow up—someday!" . . . **Tom Milkie** wrote us a letter: "After graduating I spent a year getting my M.S. at Georgia Tech, majoring in Aerospace Engineering. I did some work there in propulsion, taking high-speed movies of burning rocket fuel. After getting my degree, since I was in R.O.T.C. at M.I.T., I expected to be among the chosen people, but the army copped out and said they didn't want me. So I am now enjoying the sun in California, working for Philco-Ford's Aeronutronic Division. I am working on range safety for the Kwajalein Missile Range in the Marshall Islands." . . . **Avi Ornstein** sent us some crytarithmetic puzzles and some news: "Bernice Nowak and I have set the wedding date as next September 29. We'll be living in the Boston area for at least a year. By the way, as this letterhead shows (Blue Dragon Enterprises), my silkscreening job has taken on a title and is still keeping me going."

On some other minor notes on classmates. **Bern/Thor/Hawkeye Krafsig** will be getting married to Sandy Peavoy this summer when he gets back from U.S.A.F. training in Airport Tower Control in Texas. . . . Speaking of towers, **Len Tower**, originally of '71 has finally finished all requirements! On the same vein, **Robert/Jock Young** has registered again to continue working toward his bachelor's degree." . . . **Steve Baxter** mailed us a long one: "I just thought I'd bring you up-to-date on a couple of people that I know about. Currently I'm at the Harvard Business School with high hopes of graduating this June. After that, I go off and try to become a captain of industry—or at last a corporal. . . . **Pat Sullivan** and **Roy Schulte** are currently computer nurds at the Lahey Clinic in Boston. Roy did work for an insurance company for a while, but he longed for computers again. . . . **Skip Eby** and Pete Pathak have returned from their around the world hitchhike and mooch extravaganza (14 months worth). Pete is working as a purchasing agent for Procter and Gamble back in Toronto. Skip, after pounding the pavement for four months, finally got a job outside of Boston despite his aero-and-astro degree. . . . **Pat Cunningham** is teaching at a day-care center and is enjoying it immensely. . . . **Dave Kuhn** is a matron at a day care center in Southern California. He likes it also but will give it up when Nixon cuts off funds in April. He'll probably try to become a rock and roll star after that. His luck with bands out there hasn't been overwhelming, but he'll keep trying." . . . **Ken Weisel** is an Engineer (in training) for Stone and Webster Engineering Corp., and is living in Cambridge. . . . **Ken Madell** has been located at the Rocky Hollow Herb Farm in New Jersey.

We'll close with our usual call for people to work on the Kent State Memorial Lecture Series. We have some volunteers, but need more to get the series off the ground. Please let us know if you're interested. And of course write to us and let us know what you're doing.—**Howard Jay Siegel** and **Leah Jamieson Siegel**, Class Officers, 228C Harrison St., Princeton, N.J. 08540

72

In the December column I mentioned the cross-country bicycle trip that **Chip Kimball** and **Craig Lewis** took last summer. Through the heroic efforts of **Dan Bloom**, I finally managed to get hold of the article about it that appeared in the *Globe* on September 24 of last year. Written by Chip's brother, it was called "Finding the Worms in the Apple of America." It details the cyclists pleasant experiences with western hospitality, friendly truck drivers, and polite cows who let them pass without trouble. It also records the perils of rain in Washington State, eastern vacationers in the Cascades, and drivers in Michigan whose chief delight seemed to come from forcing cyclists off the road. . . . Another wanderer in the Class is **Don Levinstone** who has been lately reported to be variously in France, Iran, and Pakistan and moving east.

Along the line of somewhat more conventional activity, I find that **Harry Wong** and **Fritz Yohn** are both grad students at the Institute, in Chemical Engineering and Economics, respectively. Fritz is living in the new Westgate II, which gives him quite a hike to classes at Sloan. . . . **Bonny Kellermann** is a grad student in social work at the University of Chicago. . . . Also out in that part of the country, **Slaton Tuggle** is working on his Ph.D. in physics at the University of Illinois. He was married in January to Patti Jackson, a Wellesley girl. . . . **Frederick Middleton** is at Harvard majoring in Finance. . . . **Albert Sadun** writes, "I'm now at the Albert Einstein Medical School and wishing it were in Boston. The joint program (M.D.-Ph.D.) is fine and gives me a chance to escape the medical students by ducking into a lab. Learning facts for a change is fun, but I miss the argumentative Tech Tool." . . . I also got a note from **Harlan Ives**: "I have taken advantage of the no grade, no exam system here at Yale Medical School by learning to ski this season. I am now trying to decide whether to be a physician or a ski freak."

We continue to have people entering the service. **Pete Welling** went into the army for three months in March and **Ken Kempson** entered the navy about the same time. . . . Our congratulations to **Cheryl (Davidson) Martin**. She was a co-winner of the third place award in the 1972 Engineering Student Design Competition (Undergraduate Division I: Structures).

Important news to me is that I can now finally number myself among those of you who are employed. I am working for the G.E. Aircraft Engine Group in Lynn. Having only been there a month (as of this writing) I have already run into Janet Lantner and Amin Lakhani. Janet is working in the field of electrochemical machining and Amin is in the Process Engineering Department. He is living in East Boston so we share the bus in from Lynn in the evening. . . . **Marty Shinko** wrote me, starting his postcard, "Congratulations and welcome to the real world." He is working at Bettis Atomic Power Lab near Pittsburgh doing power plant analysis for the nuclear propulsion plant on a new aircraft carrier. . . . **Shabbir Nomanbhoy** found a job working in Watertown with a group designing a steam powered automobile. He is living in Brookline and has recently been busy as Chairman of a survey of Cambridge to locate architectural barriers to the handicapped.

Finally John Schenck, together with **Jack Price**, a grad student, and Mike Miller from Harvard has opened a self-service auto repair center off Beacon St. They provide the garaging and the tools at $2 an hour and you do your own work. Sounds like a good deal.—**Dick Fletcher**, Secretary, 135 West St., Braintree, Mass. 02184

Simulation in 1/100th the Time at 1/4th the Price.

That's just a fraction of our story. The new PACER™ computer systems by EAI can actually deliver price/performance ratios that run well over 100 times those of conventional digital computers. Whether the problem is simulation, optimization, control, design or data reduction.

The unique efficiency of PACER systems is due to many factors: First, they combine our new fourth-generation digital processor with three new high-speed parallel processors. New peripherals and software offer interactive graphics in a conversational mode of operation. So now scientists and engineers can achieve higher computational productivity and accuracy while tackling the complexities of multivariable problems in real time or even faster than real time.

The PACER systems simply deliver far more solutions per day or per dollar than any alternative systems.

Further, we help you zero in on optimum efficiency by offering three series of systems: PACER 500, PACER 600 and PACER 700. Each series offers three sets of options with a wide choice of peripherals. To let you choose a setup with capabilities matched almost precisely to the requirements of your problems or to your preference for input/output.

Yet there is never a need to feel straitjacketed. Because PACER systems are expandable. Almost indefinitely—including interconnection to your existing computers.

As for software, EAI can probably be of more help to you than anybody else in the world. Our library of compatible engineering and scientific software is the most generally useful ever assembled, and we have over 5,000 case histories of applications to prove it.

For details on our whole PACER story, please write or call today.

EAI

Electronic Associates, Inc.
185 Monmouth Parkway
West Long Branch, New Jersey 07764
(210) 229-1100

Conversation Pieces

Technically intriguing items from TRW, guaranteed to add luster to your conversation and amaze your friends.

Automatic Zero-visibility Landings If you travel by air frequently, you've probably had the experience of flying *almost* to the airport of your destination and then being diverted to a nearby city. The usual reason—fog. The radio beacons which guide your plane through its instrumented landing system (ILS) don't function accurately enough at altitudes under a few hundred feet. And that's where the fog is. Their accuracy is degraded because close to the ground the long wave-length radio signals on which conventional ILS operate are scattered by heavy rain or fog, and they reflect off buildings, trees, and other ground-based objects.

Suppose that instead of a low frequency radio beacon, however, you had very high frequency (i.e., gamma radiation range) signal with which to work. Properly collimated, such a signal could penetrate the fog and rain while remaining immune to the problems of ground scattering. This is the approach TRW Systems has taken in its Nuclear Instrumentation Landing System (NILS). NILS shows promise of guaranteeing safe, automatic, zero-visibility landings. It can be used as a primary guidance device or as an independent monitor for the next generation of microwave guidance systems now being developed by the Federal Aviation Agency.

NILS is a short-range guidance system which provides highly accurate aircraft position information during the last phases of descent, touchdown and rollout (see Fig. 1). Two NILS beacons give the aircraft position information while it is on the final portion of the approach, and two others as it lands and rolls down the runway. Each beacon contains a collimated radioactive source which emits high frequency radiation. Mechanical shutters within each beacon modulate this signal into two overlapping beams of radiation (see Fig. 2). On board the descending plane is a radiation detector. The radiation pattern of the pairs of beacons is such that when the plane is exactly on-course, it receives equal amplitudes of all four frequencies.

Under joint Atomic Energy Commission and Federal Aviation Agency sponsorship, we have developed and are testing full scale versions of it. Now we are getting it ready for extensive testing by the FAA. If NILS helps to land your plane in a fog some night, you'll know that it has been checked out by some of the best pilots and engineers in the U.S.

Fig. 1 NILS System

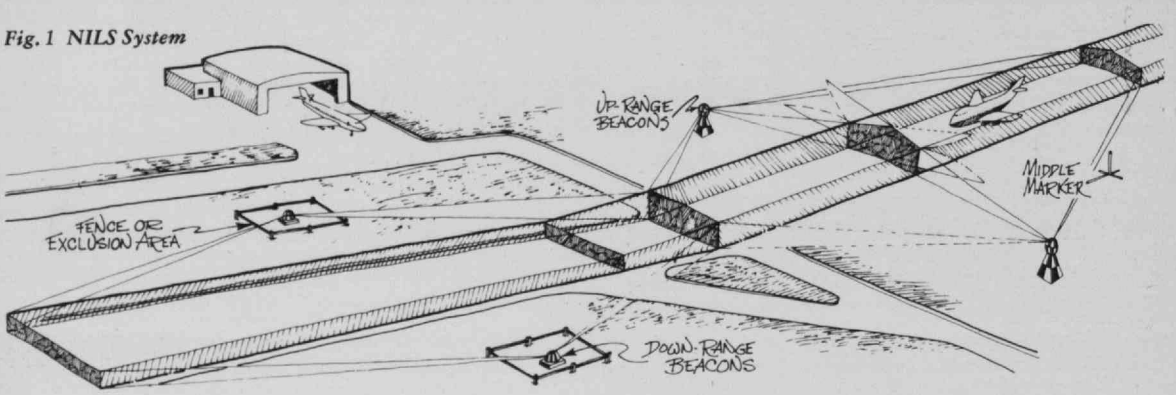
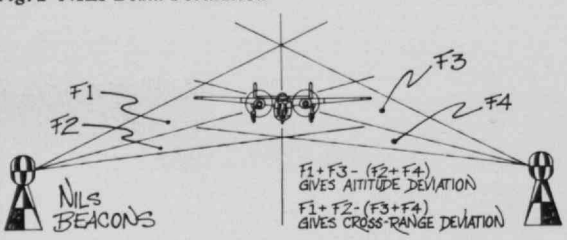


Fig. 2 NILS Beam Formation



For further information, write on your company letterhead to:

TRW
SYSTEMS GROUP

Attention: Marketing Communications, E2/9043
One Space Park Redondo Beach, California 90278